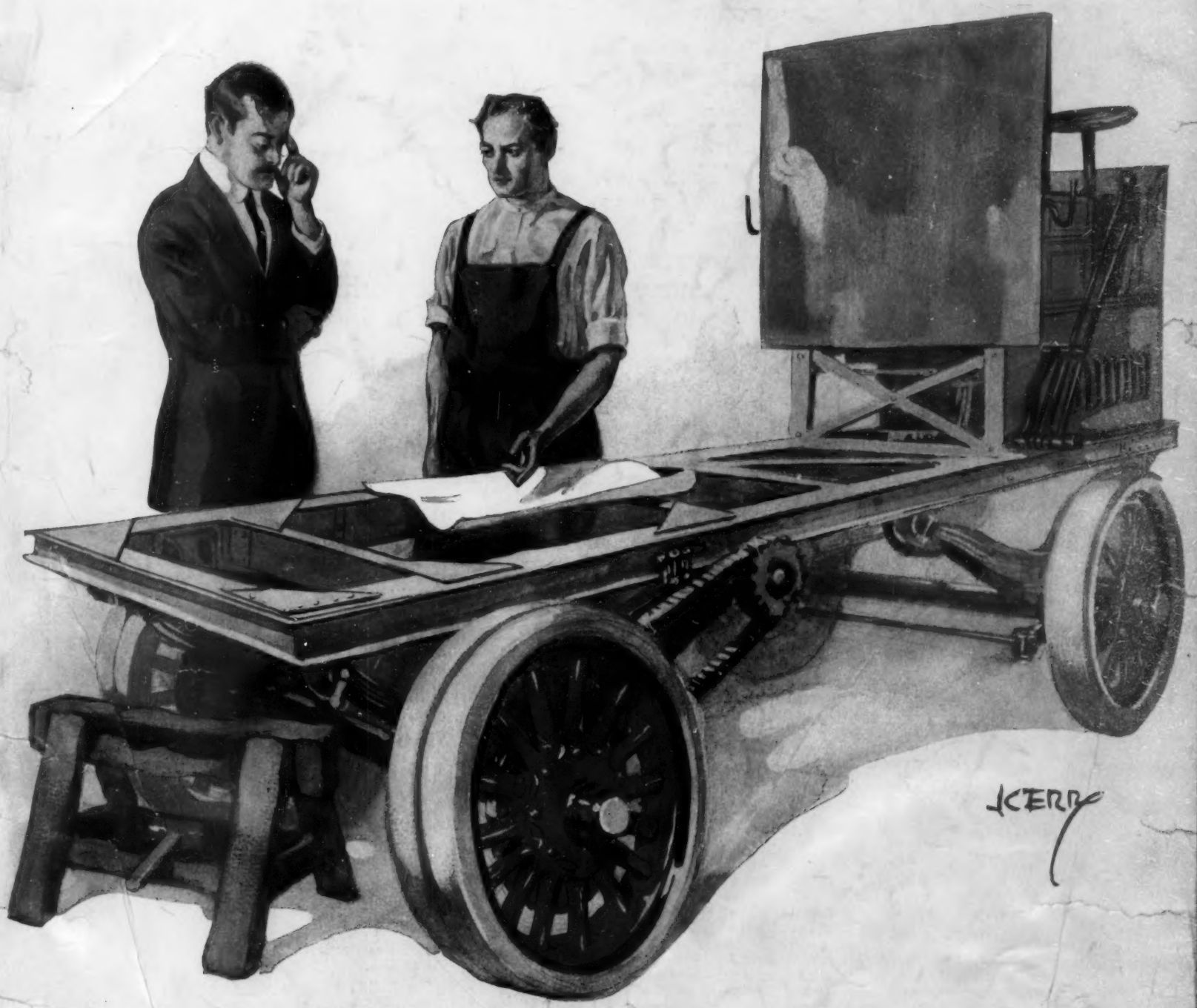
SCIENTIFIC AMERICAN

Annual Motor Number



Vol. CVI. No. 1
January 6, 1912

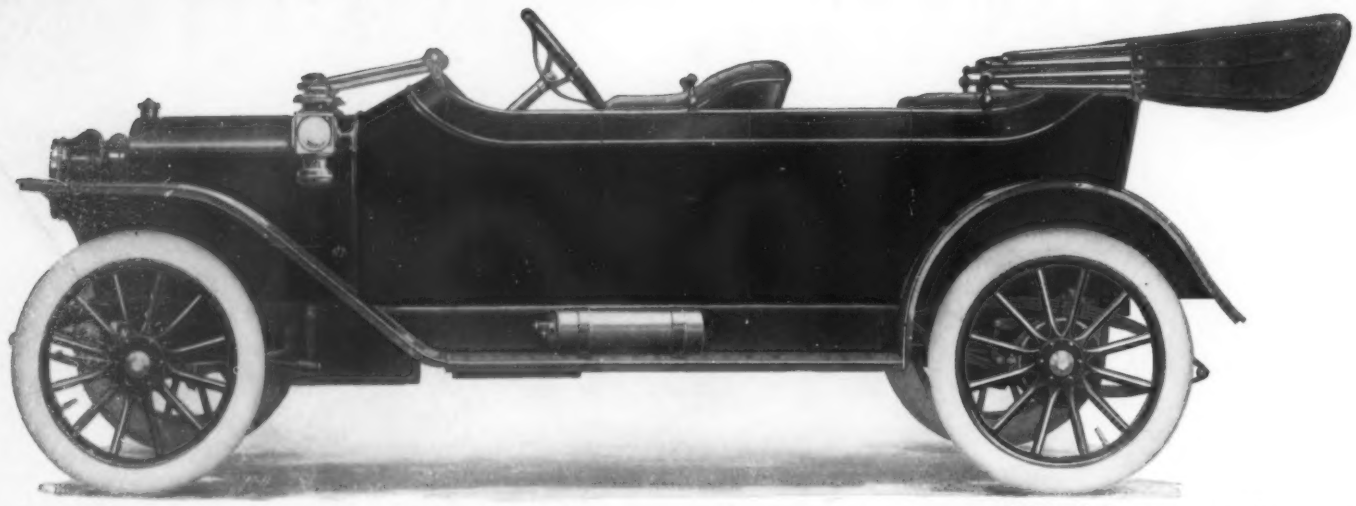
Munn & Co., Inc., Publishers
New York.

Price
15 Cents

R-C-H

"Twenty-Five" 5-Passenger Touring Car

110-Inch Wheelbase



$850
F. O. B. Detroit

Fully equipped with top, side-curtains, windshield, 2 gas lamps, 3 oil lamps, horn, tools and tire repair kit---long stroke motor---3 speeds---enclosed valves---Bosch magneto.

Seven R-C-H Features—and Their Cash Value on a Car

We want to place the wonderful value of the R-C-H before you in concrete form---we want you to know, as we do, that nothing approaching it has ver before been offered to motor-car buyers---that it is in a class of its own.

So we've listed below seven of the special features of the R-C-H which are found in no other car at near the price. And we've placed after each feature a sum which represents an estimate of the amount which it adds to the value of a car—or the amount which its absence should deduct from the cost of a car. You'll say that these features are worth more—and they are; but we have made the figures low so as to give other manufacturers every possible advantage in the comparison.

Note the astounding totals—and use these figures as a test and a guide in your choice of a car for 1912:

1.	Full five-passenger body with the latest European ideas in design and finish (not used in any other American car costing less than $4,000)	**$200**
2.	Really long-stroke motor—that is, with stroke long in relation to bore—3 1-4 x 5—powerful, efficient (used on high-grade European cars costing up to $5,000) . .	**200**
3.	The use of 130 drop forgings (more than on any other car in the world irrespective of price), both forgings and other materials of the highest grade of mechanical workmanship. Accessibility and complete interchangeability of all parts. (These features are found only in other cars costing $1,800 or more)	**200**
4.	Three speeds forward, one reverse, with sliding gears (found in no other car under $900)	**50**
5.	Long wheelbase and special spring suspension, insuring easy riding qualities found on no other car under $1,100	**100**
6.	Full equipment of top, windshield, lamps, etc., with 3 1-2 inch tires (found in no other car under $900)	**50**
7.	Highest grade magneto made—perfect magneto satisfaction on any car is easily worth	**50**
		$850

v then. Each one of these features, by reason of its greater ease, fficiency or greater durability, is well worth on any car the sum we pposite it by all accepted standards of value. Ninety-nine motorists undred would cheerfully say in each case: "Yes, I'd sooner pay the and have that." Yet the sum of these fair valuations just equals the e R-C-H.

well. Then you're offered any car, find out if it lacks any or all of ial features. If it does, deduct their value from the price a But Add a reasonable sum for any features of value—if you R-C-H hasn't got. Then compare the respective p d the other.

That's the way we want to sell the car.

Write for folder, or call at nearest branch.

Dealers: Write—or better still, wire. We still have a little unallotted territory.

See these wonderful cars at Booth B—first floor, Grand Central Palace Show, January 10th to 17th.

Canadian Prices: R-C-H 2-passenger roadster, $850; equipped for four ngers, $925. R-C-H 5-passenger touring car, $1,050. R-C-H Gasolin 200 All prices F. O. B. Windsor, Ont., duty paid.

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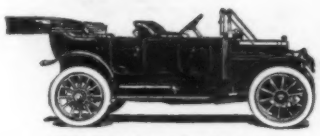
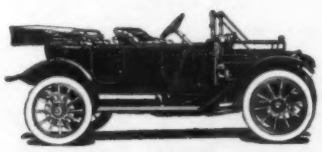
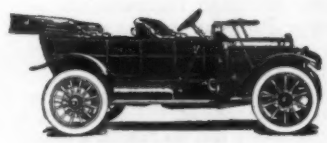
World-wide confidence in the Cadillac amounts to a deep-rooted conviction



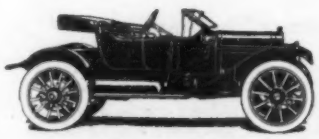
TOURING CAR, $1800



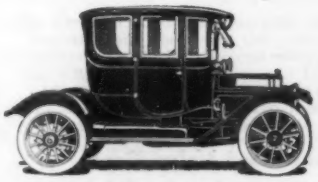
PHAETON, $1800



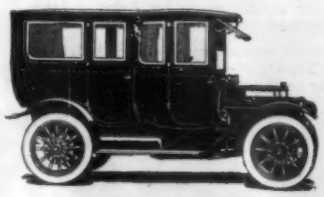
TORPEDO, $1900



ROADSTER, $1800



COUPE, Four passenger, $2250



LIMOUSINE, Seven passenger, $3250

Prices are F. O. B. Detroit
Including Standard Equipment

You will find your Cadillac dealer booking orders and making deliveries in the most "difficult" motor car months of the year.

Therefore, if you have not already placed your order do not be surprised if you find that he cannot "date" the delivery of your car for some time to come.

Stop and consider a moment.

We do not know where you may happen to be when you read this announcement.

It may be in New York; or it may be in San Francisco; or it may be in Arizona.

But wherever you are, there—in your home town—is the same intelligent, inflexible, and implicit confidence in the Cadillac which you encounter everywhere.

If you are one of two million people who read it, you are one of two million people who have felt the influence, the impact, of Cadillac reputation.

You may be on a train at this moment. If so, there are probably others near you who give precedence to the Cadillac just as you give it.

The section through which your train is speeding is permeated and saturated with Cadillac enthusiasm.

This year that sentiment is intensified.

The electrical system of starting and lighting has helped greatly.

But much more potent is the swelling appreciation of Cadillac standards, enhanced with every year that passes.

It is literally true that it is not possible to remain faithful to Cadillac ideals and supply the demand even with the resources of this great plant.

It is true that your dealer and other dealers cannot buy as many Cadillac cars as they could sell.

It is true that Cadillac demand rises superior to "seasons" and that orders and deliveries must be placed ahead in order to avoid disappointment.

STANDARD EQUIPMENT—Dynamo with 80 A. H. battery for automatic starter, electric lights and ignition. Also Delco distributor ignition system with dry cell current. Lamps, Gray & Davis, especially designed for Cadillac Cars, black enamel with nickel trimmings; two head lights with adjustable globes to regulate light rays; two side lights, tail light. Hans gasoline gauge on dash, horn; full foot rail in tonneau, half foot rail in front; robe rail, tire irons, tool box, set of tools including pump and tire repair kit; cocoa mat in all tonneaux except closed cars. Speedometer, Standard, improved with 4 inch face and electric light.

CADILLAC MOTOR CAR CO., Detroit, Michigan

SIXTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

Vol. CVI. Saturday, January 6, 1912 No. 1

ANNUAL MOTOR NUMBER

Contents

Cover Design by George Kerr

Munn & Co., Inc., Publishers 361 Broadway, New York

Siegel-Cooper, NEW YORK. Iroquois Hotel, BUFFALO. Normal and Latin School, BOSTON. Metropolitan Life Insurance Building, NEW YORK. Billings Hall, Wellesley College, WELLESLEY.

Herald Building, NEW YORK. Hudson Terminal Building, NEW YORK. Fred Loeser & Company, BROOKLYN. Bellevue-Stratford Hotel, PHILADELPHIA. Martinique Hotel, NEW YORK. Onondaga Hotel, SYRACUSE. Colgate Building, JERSEY CITY. Citizens Savings and Trust Building, CLEVELAND. Carnegie Building, PITTSBURGH.

Hamburger's Department Store, LOS ANGELES. Bellevue Hotel, SAN FRANCISCO Southern Building, WASHINGTON. Rockefeller Building, CLEVELAND. Wells Fargo Building, PORTLAND Broad Street Station, PHILADELPHIA. Carson-Pirie-Scott & Company, CHICAGO. First National Bank Building, CLEVELAND. Memorial Hall, Harvard University, CAMBRIDGE.

Monadnock Building, SAN FRANCISCO. Dey Brothers Store, SYRACUSE. Times Star Building, CINCINNATI. Land Title & Trust Building, PHILADELPHIA. Auditorium, CANTON. North (or B. & M.) Station, BOSTON. Central Building, NEW YORK.

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If *all* the buildings lighted by Edison Mazda Lamps could be grouped together the result would be a city composed of the leading hotels, largest stores, most modern office buildings, banks, theatres, colleges, schools, museums, hospitals, factories, railroad stations, municipal and private buildings of all kinds—and hundreds of thousands of homes.

Only a very small city can be shown here, but in these three dozen buildings there are 200,000 Edison Mazda Lamps giving a total light of over 6,000,000 candle-power. Nineteen cities are represented by buildings well known locally, and in some cases, nationally. One of these is the largest and another the tallest office building in the world.

Millions of these sturdy Edison Mazda Lamps are used in buildings of all kinds, on automobiles and railroad trains, and in all places where any electric incandescent lamp can be used. Edison's dream of "Electric-light-for-everybody" has come true.

Begin today to use this lamp that gives nearly three times as much light as the ordinary carbon filament lamp consuming the same amount of current.

Your lighting company or electrical supply dealer will furnish any size from 25 to 500 watts, plain or frosted. Be sure you get Edison Mazda Drawn Wire Lamps—the G-E monogram on the package and on the lamp is for your protection.

Which of the following 20 to 40 page, illustrated pamphlets shall we send:

"The Lighting of Hotels and Cafes"
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SIXTY EIGHTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CVI.] NUMBER 1.] NEW YORK, JANUARY 6, 1912 [15 CENTS [$3.00 A YEAR

A load of stone for road building on J. D. Rockefeller's estate, Pocantico Hills, N. Y.

The Selection of a Motor Truck

Leading Features of This Year's Models

By Harry W. Perry

So many considerations are involved in the selection of motor trucks or delivery wagons for any given business that the matter really becomes a transportation problem. The best advice that can be given the man who is in the market for power wagons, if he has not had experience with them recently, is to lay his case before a transportation expert. The advice of the expert can be obtained without charge, as most of the long-established truck manufacturing companies have attached to their selling corps, one or more engineers who have for years made a special study of the adaptation of the motor-driven vehicle, in its many types and capacities, to all sorts of requirements.

These men are, of course, in the business primarily to sell the machines in which they are interested, but it is well understood by them and by the companies they represent, that it is an exceedingly bad policy to induce a man to buy a machine that is not suitable for his work, because the condemnation of the truck or wagon by one user can do more harm than will be undone by half a dozen satisfied users. Truck makers depend very largely upon re-orders for their sales—some claim that repeat orders from former purchasers constitute from 60 to 70 per cent of their sales, which could not be the case if they recommended their machines for services that they could not perform satisfactorily.

There are two main lines of thought to be followed in coming to a decision, whether the purchaser seeks the expert first or last. One is directed toward the nature, volume, and peculiarities of the business in which he is engaged, so far as these have a bearing on haulage and delivery; the other, to the characteristics of the motor vehicles from among which his selection is to be made. These considerations must be brought into harmony, if a wise choice is to be made, because the selection of a machine suited to the particular requirements in each case is the most important point of all in buying motor trucks and delivery wagons. After that, in order of importance, come reliability, meaning regularity of service day in and day out; radius of action and ability to traverse streets and roads under all weather conditions; cost of maintenance, including repairs and tires; accessibility of mechanism; durability or rate of depreciation; simplicity; cost of operation; first cost of machine; and many secondary considerations. Nearly all of these points are involved, however, in picking a type and size of machine befitting the nature and volume of the work to be done.

A large manufacturer or wholesale house located in a large city where streets are generally well paved and level, and heavy loads are to be hauled short distances, will probably find the electric truck of three to five tons capacity suited to his needs. Electric trucks have a mileage capacity of from 25 to 50 or 60 miles on one charge of the battery, depending upon the size of the machine, the size and kind of battery used and the road conditions. Gasoline trucks, on the other hand, have an unlimited mileage capacity, for their tanks may be refilled with gasoline almost anywhere. One would suppose that a range of 50 or 60 miles would be ample for all city trucking; however, trucks used in the city are frequently called upon to do a hundred or more miles per day. Hence it is improper to speak of the gasoline truck as suitable for work in the suburbs and the country only, and the electric truck as meeting all the requirements of the city. Many companies use both types of vehicles so that one will complement the work of the other.

Electric vehicles have the battery and all machinery located below the level of the platform, which leaves the whole length of the platform unencumbered and capable of receiving loads. This is important in certain lines of business, as in the handling of iron and steel bars and rods, signs, railings, lumber, and stage scenery. All such stuff can be loaded on the truck so as to extend beyond the front end as well as the rear, the driver's seat being placed on a small pedestal at one corner.

Electric trucks are best adapted for use in large "fleets" by department stores and others doing a large volume of trade, because they require charging facilities and should be under the supervision of a battery expert. It does not pay to provide these for only one,

(Continued on page 16.)

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, JANUARY 6, 1912

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary and Treasurer; all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter

Subscription Rates

Subscription one year $3.00

Postage prepaid in United States and possessions, Mexico, Cuba, and Panama

Subscriptions for Foreign Countries, one year, postage prepaid. 4.50
Subscriptions for Canada, one year, postage prepaid, ... 3.75

The Scientific American Publications

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Scientific American Supplement (established 1876) . " " 5.00
American Homes and Gardens . . . . . " " 5.00
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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Time is Money

IN order to save twenty minutes on the running time of its fast trains between New York and Buffalo, the Lackawanna Railroad Company has built a cut-off which has cost a round sum of eleven million dollars. Time-saving does not, of course, represent all of the return on this investment. The total distance is shortened by eleven miles, and the maximum grade is reduced from 60.2 feet per mile to 20.04 feet, and 1,560 degrees, or over four complete circles of curvature, are eliminated. This work is the latest and most striking example of a policy of reconstruction, which has been carried through on a most extensive scale by the leading railroads of this country, in which hundreds of millions of dollars have been expended. The shortening of distance, the saving of time, and, above all, the reduction of grades, have made possible an annual saving of operating expenses, which represents a fair working interest on the outlay for construction.

The new line, which extends from Lake Hopatcong on the east to the Delaware Water Gap through the Blue Ridge Mountains, is unquestionably the most expensive stretch of trunk line railroad in the world. It is carried boldly, at a practically level grade, through mountain and valley, and the construction is of an absolutely permanent character. Where the engineer encountered projecting bluffs, he carried his line at grade by blasting out deep through cuts, and when wide stretches of valley were to be crossed he did not, as in the days of pioneer railroad building, dip into the valley by steep descents and climb out of it by equally heavy grades when the hills were again approached. Instead, he held his line at the predetermined level and carried it on solid fills that were miles in length and over a hundred feet above the floor of the valley.

But this part of the story is best told in figures of length and quantity. Across the Pequest Valley has been built the largest railroad fill in existence—105 feet in height and over three miles in length. In the twenty-two miles of new line there are 73 bridges and culverts of reinforced concrete, among which are included a concrete bridge 1,100 feet in length, and the handsome structure that carries the line across the Delaware, which has an over-all length of 1,450 feet and includes five arches each of 150 feet span.

Not merely in the magnitude and permanence of the work, but also in the methods adopted, the construction of this line illustrates the high level of efficiency to which modern railroad building has been carried. The most notable feature was the method of constructing the fills by means of a suspended aerial cableway, from which was hung a movable bridge floor capable of supporting a train of dump cars above the center line of the fill. The excavated material from the cuts was run out above the fill and dumped accurately in place by the train load. Had this great work been attempted by the methods of construction which prevailed in earlier years of railroad building—by shovel, scraper and cart—the total cost would probably have been more than doubled.

Imagination as a Scientific Asset

THERE is a tendency among some lay persons, and, we fear, among some engaged in a certain type of scientific work, to suppose that the faculty of imagination, however valuable to the artist, is dangerous rather than helpful in the pursuit of exact science. The layman, especially if he takes a considerable interest in art and literature, is rather inclined to look upon science as something dry, followed with more or less enthusiasm by persons devoid of a finer sense of beauty in form and being, and attracted in the majority of cases by the prospect of material rewards which the application of science to useful ends may bring. Again, the plodding scientific worker of the rank and file, doing his service faithfully in the performance of routine tasks—who never knew the glory of creative inspiration—he, too, is disposed to look upon imagination as a useless and dangerous thing: as liable to substitute for an *observed fact* some *imagined speculation*. And perhaps for lesser minds this danger is a real one. Not so for the great masters of science, who have borne ample testimony to the value, nay, the indispensable need, of imagination for the successful attack of the major problems. And brief reflection shows that this must be so, for this faculty of imagination serves a double function. It is true that in the mind of the artist its principal mission is to set up before the inner consciousness a mental picture of some fictitious scene or circumstance, the very creature of the artist. But the imagination has also quite another purpose to fulfill—one which, while no less exalted, is more closely connected with the real world. It is not enough for a man to have cognizance of a variety of facts and relations. We all have heard of individuals who are aptly described as "walking cyclopedias," and we know, too, that as a rule such men, while they may be useful as sources of varied information, are usually unproductive of new discoveries or original ideas. No poetic flight of fancy was ever more magnificent than the feat of scientific imagination that traced the descent of higher mammalian species from a tiny fragment of primeval protoplasmic jelly. It is not enough, we repeat it, merely to have one's mind filled with a large mass of more or less disconnected facts. If such material is to bear fruit in the mind that holds it, the individual must have, in ample measure, the faculty of summoning before his mind's eye, in orderly relation and arrangement, such of the facts at his disposal, as are linked together by some important thread, some regularity, or law. It is not too much to say that the vaster a man's knowledge, the more important does it become for him to possess that imaginative faculty which enables him to throw up on the screen of his consciousness all such records of his past experiences and perceptions, as are vital to the question which he is revolving in his mind. This faculty of calling up mental pictures can hardly be over-estimated as an aid to the man engaged in intense scientific pursuit. It is true that mental habits differ both among those of ordinary caliber and among the great; thus, men like Mach and Ostwald are strong in their advocacy of a point of view as free as possible from hypotheses. Such men are somewhat disposed to condemn the use of mental pictures. Against this it must be urged that the position which they take is probably altogether inconsistent, and one finds it difficult to believe that these men themselves have produced their work without the use of such pictures. Indeed, the ionic theory, so greatly furthered by Ostwald, in the minds of most people partakes very strongly of the nature of a mental picture, although it must be admitted that possibly in Ostwald's mind this feature is absent from the theory. In this connection, too, it is worth while to recall what Nernst says with regard to the use of such mental pictures as that of an ideal osmotic cell. The use of the imaginary processes performed in such cells has been rather severely condemned by Van Laar, for example, who favors a purely mathematical treatment of the cases in point. Speaking of this, Nernst says, that while such mathematical treatment may be indeed very desirable as a final polish, it is observable throughout the history of the development of theoretical chemistry, that the men who made discoveries and developed new results made use of the more suggestive, if less elegant, method of mental pictures.

Giving due consideration to all facts, the conclusion which one naturally reaches—a conclusion which is, on the face of it, reasonable, though perhaps somewhat trite—is that imagination has indeed a very high value for men of science, but that it must be held in check; for, like a spirited horse, it is apt to run away when the reins are in the hands of an unskilled rider.

Battle-cruisers for Our Navy.

IT is urged by Secretary Meyer that if we are to prevent a positive decrease in the effective strength of our armored fleet, we must add at least two battleships yearly to our navy. The older battleships become obsolete through age; the new ships are necessary to maintain our standard.

Also he advocates the construction of a battle-cruiser; this vessel to be additional to the two battleships. We consider that a ship of this type should be put in hand at once. The absence of battle-cruisers would place us at a very great disadvantage in any operations against a navy that was strong in this particular type. The American navy should possess ships at least equal to those possessed by foreign powers, class for class. If that principle be admitted, it follows that the magnificent ships of the "Wyoming" and "New York" classes should be represented by one or more 26 to 28-knot, big-gun ships in the battle-cruiser class.

It is well known that the construction of armored cruisers of the pre-dreadnought type has fallen off considerably in recent years, but a battle-cruiser for Japan was laid down in England last January, and Great Britain has four complete, four launched and two building or provided for, and Germany has two complete, one launched and two building.

Nothing is known of the Japanese vessel, but of the British, six (17,250 to 18,750 tons) are armed with eight 12-inch guns and two (26,350 tons) with eight 13.5-inch. The earliest German ship, "Von der Tann," displaces 19,100 tons and carries eight 11-inch, but the "Moltke" and "Goeben" are of 23,000 tons and have ten of these weapons.

The principal argument urged against the type is the fact that guns or armor, or both, have to be sacrificed in order to achieve the desired speed, and that high speed itself is unnecessary and confers no advantage upon the ship possessing it except the ability to run away. The objection is undeniably true. A warship is a compromise, and any attribute, such as speed, can be increased only by the reduction of some other, such as armament or armor. This is well illustrated by comparing the British battle-cruiser "Lion" with the battleships of the "Orion" class. The latter displace 22,500 tons, have 12-inch belts, are armed with ten 13.5-inch guns, and are designed for 21 knots. The "Lion" is designed for 28 knots; and although she sacrifices two big guns and 3 inches of side armor, her displacement is no less than 26,350 tons, while her total cost, exclusive of guns, is $9,376,220, as compared with $8,849,470 for the "Orion." These differences are fully accounted for by the fact that the battleship is well served with turbines of 27,000 horse-power, whereas the cruiser requires no less than 70,000 horse-power for her propulsion. The propelling machinery of the "Lion" cost $2,351,165, or 25.1 per cent of the total cost of the ship (without guns), while that of the "Orion" accounts for only $1,223,265, or 13.8 per cent of the total. On an average, the machinery of a 21-knot battleship accounts for 16 per cent of the total cost.

On the other hand, the cost per horse-power in cruisers is considerably lower than in battleships, and is diminishing at a more rapid rate. This will be seen from the facts that the engines of the battleship "Bellerophon" (1906), of 23,000 horse-power, cost $61.7 per horse-power, and those of the battle-cruiser "Invincible" (1906), of 41,000 horse-power, cost $57.6 per horse-power, whereas the engines of the "Orion" (1910), of 27,000 horse-power, cost $45.8, and those of the "Lion" (1910), of 70,000 horse-power, cost $33.6 per horse-power.

The design upon which, for informative purposes, the Bureau of Construction is engaged is said to provide for a battle-cruiser with a designed speed of 26 knots and an armament of ten 14-inch guns. Such a ship must be considerably larger than the battleships of the "New York" and "Nevada" classes, which have the same armament, but a speed slower by four knots. The increase would be most pronounced in the length. The British cruiser "Lion" has the same beam as the battleship "Orion," namely, 88½ feet; but she is 660 feet long, as compared with 545 feet, and this in spite of the fact that she has only four turrets as compared with the battleship's five.

In most dreadnought battleships, American and other, the ratio of length to beam is 6:1, and in most battle-cruisers, 7:1. In the case of the "Lion," however, it is 7½:1. Altogether, it would be a matter of surprise if ten 14-inch guns could be accommodated on a beam of less than 95 feet; and that, according to foreign practice, means a length of between 665 and 712 feet and a displacement of between 31,000 and 33,000 tons, with engines approximating 90,000 horse-power.

The Riding Qualities of a Car

Science of Springs, Upholstery, and Shock Absorbers

By S. W. Harvey

So much is demanded of the modern motor-car in the point of service, comfort, efficiency and economy that it is indeed a wonder that a single machine can be built to fulfill such a variety and multiplicity of requirements. Among these requirements, the motor car must combine the ease of riding of the light, horse-drawn buggy or phaeton with the speed of the express train, and in addition must carry over rough roads a load as heavy as that borne by the ordinary truck. The buggy is easy-riding, but it is light and does not travel at high speeds; the locomotive is speedy, but it runs over smooth rails under the most favorable conditions; the horse-drawn truck can carry heavy loads over rough roads, but it is slow and is *not* easy-riding; but the motor car must possess the good qualities of all these vehicles with the drawbacks of none.

The requirements of easy riding would be reason enough for the use of the best spring design and material in a motor car, but when it is remembered that the long life and efficient service of the motor, transmission, clutch, and other parts of the driving mechanism depend, to a large extent, upon freedom from severe shocks and jolts and excessive vibration, it will be seen that the proper mounting of the chassis is doubly necessary. Pneumatic tires serve to absorb many of the minor vibrations between the road and wheels caused by a rough surface, and are of great assistance in cushioning the "blow" caused by striking a depression or obstacle, but their action is limited through too small a radius to enable them more than to supplement the main supporting springs of the car. Whatever shocks or vibrations are received by the wheels must be transmitted to the springs, which are mounted on the axles, and whatever jars these springs fail to absorb are communicated directly to the frame, body, and power plant of the car.

Any resilient steel piece can be used to absorb a part of the vertical motion of the wheels, but the design and shape best suited to serve as a spring depends upon a variety of conditions under which it is to operate, and what may be applicable to one car may be absolutely unsuited for use on another. Some of the lighter cars employ a pair of spiral springs for supporting the frame at each of its four points and prevent side sway by the use of an ingenious flat-forged arm, one end of which is attached to the frame and the other to the axle. This arm must, of course, be hinged at one point to allow for the vertical motion between the wheels and the body.

But it is probably the leaf spring that is best known, and this type has been designed to meet the requirements of all kinds and conditions of cars, from the 600-pound runabout to the 10-ton truck. This type of spring obtains its name from the fact that it is built up from a series of long and narrow steel strips called leaves. These leaves are of varying lengths but of the same width. The longest leaf is the first and constitutes the length of the spring, while each succeeding leaf is slightly shorter than the one that preceded it. Thus the outline of the complete spring may be said to resemble a "flat" pyramid. When one such spring is used at each supporting point of the car, it is known as the "semi-elliptic" type; while two such springs placed "facing" each other, or with the long leaves connected at their ends, constitute a "full-elliptic" design. The upper spring may be only half the length of the lower one, in which case the two portions are known together as a "three-quarter-elliptic" spring. As a rule there are four points at which the frame of the car is supported on the axles, and it is at each of these points that a full, three-quarter, or half-elliptic spring is used. In place of two springs at the front or rear, however, we sometimes find a single spring placed parallel with the axles and supporting one-half of the frame at a single point. Although this is also a leaf spring, the method of suspension is known as the "platform" type.

But it is upon the action of the leaves themselves, and consequently of the springs of which they form a part, that the easy-riding quality of a car depends, and even though the leaf spring has been in use for over a hundred years, only recently have manufacturers turned their attention to the *science* of the design of motor car springs. The behavior of the springs under various conditions depends almost entirely upon the material of which the various leaves are composed, and upon the dimensions of the spring as a whole. Spring material is practically restricted to three steels, chrome-vanadium, silico-manganese, and the French analysis of open-hearth steel, for these are the materials that possess the necessary qualifications in the highest degree. Such steels have high tensile strengths and elastic limits and can withstand the largest number of oscillations before "fatigue" occurs. But it is in the heat-treatment of these steels, as well as in the analysis of the alloys, that great care must be taken, and if a leaf is not "quenched" at the proper point, or is allowed to become heated to too high a temperature, it may be rendered too brittle, too soft, or not sufficiently resilient.

But with steels of the same quality, the action of the spring depends upon the shape of the leaves—such as proportion of thickness to width and length, and their taper at the ends—and upon the actual dimensions. For instance, the wider the leaves of a spring, the greater will be the load that this spring can carry safely; while the opposite is true in regard to the length. The deflection of a leaf spring varies directly as the square of its length and inversely as its thickness. The deflection also varies in direct proportion to the load applied. But it must be remembered that the load carried by the ordinary motor car varies, and yet that easy riding is expected whether a touring car is occupied by one person or by seven. But the deflection of a spring under a light load will not be as great as when a heavier weight is applied, and consequently a spring that is properly proportioned to meet the latter requirement may be too "stiff" to give easy riding under the first condition. Thus the motor car designers must meet the problem of finding the "happy medium" design of spring that will be neither too stiff nor too weak under any conditions of load.

When the spring acts, or, in other words, when it is flattened, it absorbs energy which will eventually be given out. When the spring is flattened through the inequalities and obstacles of a rough road, the energy of each shock is stored in the springs and then is given forth again almost immediately in the form of a violent recoil which will probably throw the body of the car above its normal position. It is the purpose of "shock absorbers" to absorb this recoil and prevent the sudden rebound of the body, and this is accomplished by offering a resistance to the return of the spring so that it will resume its normal position more gradually than would otherwise be the case. Some of these are in the form of springs themselves, others employ friction, while still a third type consists of a plunger acting in a cylinder filled with oil. To enable the same car spring to give the same flexibility with varying loads, springs have been designed to be used in conjunction with the lower half of the elliptic spring. One of these is in reality an additional lea of special shape that is attached to the long leaf of the lower elliptic spring and that acts only when the car is loaded beyond a certain point. On the recoil, this additional leaf acts with a force increasing in proportion to the distance beyond the normal that the car rebounds, and thus the ordinary car spring is stiffened for heavy loads and made more resilient for light loads.

If the leaves of a spring have not been properly heat-treated, a permanent "set" may take place which will cause the car to "ride" lower than was the case when it was new. Within certain limits, this is proper and is to be expected, but it should not be sufficient to be noticeable except by careful measurements. Instances have been known in which the forward springs have been improperly designed or heat-treated, resulting in an unequal sag at the motor end that is liable to make complications in the operation of a splash lubricating system.

Leaf springs are fastened to the axles by "clips" at the center and to each other or to the frame by "shackles" at each end. On light cars, this method of securing the axles to the frame is sufficient to care for the thrusts and side pull of driving and rough roads, but on heavier cars, the springs should serve only to support the body and running gear and to absorb the motion between these and the axles. Consequently torsion and torque or radius rods are used to "tie" the rear axle to the frame and to bear all of the strain of the twists and pulls which would ordinarily be communicated to the springs whenever the rear wheels drive the car or the body swerves from one side to the other. In this connection, it is interesting to observe to what an extent the proper "balance" of a car, or the distribution of its weight on the wheels, affects not only its easy-riding qualities, but its speed and safety, as well. The best of springs are of but little avail if the excessive "bounding" and swerving of the car are due to a top-heavy design or to a poor proportion of wheelbase to weight and body length. In general, the longer the wheelbase of the car, the better will be its riding qualities, but the wheelbase is limited to a length that can be handled and turned easily under ordinary driving conditions. For this reason, pleasure cars having a wheelbase greater than 140 inches are rarely manufactured, except for special purposes. A car in which the weight is not properly distributed or the dimensions properly proportioned will be dangerous to drive at high speeds because the rear wheels will not "stick to the road" and will swerve from side to side and skid at the least occasion. Under these conditions good traction is impossible, and as the wheels may spend half of the time "in the air," it will be seen that a large part of the power of the motor delivered to the driving axle will be wasted. Springs are not the only consideration with which the designer has to deal in producing a car of easy-riding qualities.

After the tires and springs have done their share toward absorbing the road shocks, there is still a considerable amount of motion that will be communicated to the body of the car. Luxurious upholstery is now a feature of motor car construction, and some manufacturers have gone so far as to furnish the backs and seats of the touring cars and limousines with cushions that are ten inches thick. These cushions are composed of fine curled hair and spiral springs, the latter being of such length that the side sway of the body of the car can be cared for as well as the vertical motion.

The problem of easy riding has of late years received so much attention from manufacturers that they are now paying, in some instances, close to fifty cents a pound for the steel of which the springs are composed. This is in striking contrast to their attitude a few years ago when ten-cents-a-pound steel was good enough for any part of the car and it was only a matter of luck whether the springs performed their duty well or not. The laboratories of many automobile factories are now equipped with delicate instruments which test the quality and characteristics of every spring before it is placed on the car, and as a result spring failures are less frequent than was the case in the early days of motoring.

"Science and the Soil"—The Scientific American's February Mid-month Number

THE topic selected for the February mid-month number (February 10th) is "Science and the Soil." Articles will be published to show the part played by the chemist and the engineer in lifting agriculture to the dignity of an applied science. One of these articles on the chemistry of soils will show that if the farmer is to derive the utmost benefit from his land he must know it as a chemist knows it. There also will be articles on farm mechanics, with particular reference to the part played by the motor vehicle in saving farm labor. The most dramatic aspect of modern American farming is the use of the traction engine plow, a subject which will be handled by one of the leading experts in this country.

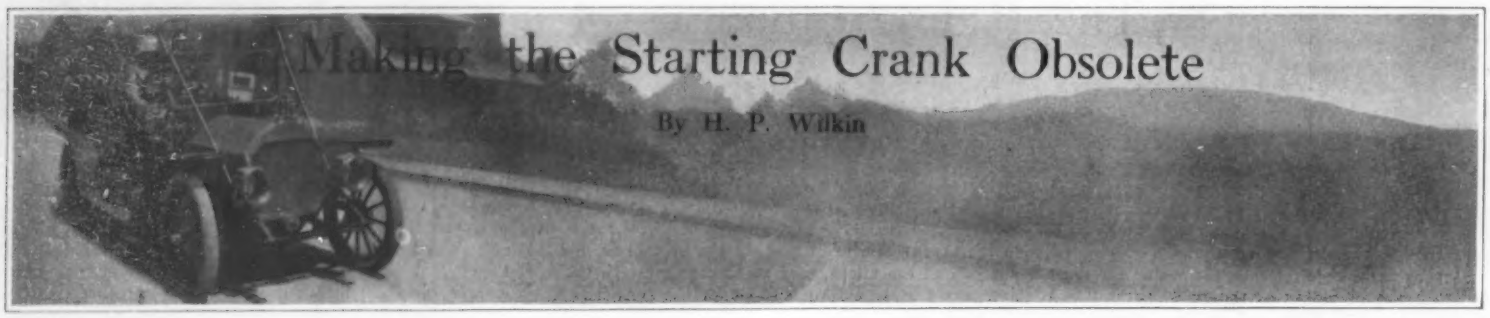
Besides these special articles, the number will contain the usual SCIENTIFIC AMERICAN material.

A New Process of Anaesthesia

IN a daily newspaper of New York appeared recently an account of a new method of administering ether and chloroform in surgical operations, a method said to have reduced the risk of anaesthesia to nothing, and to have eliminated in ninety per cent of the cases the nausea which has usually affected patients after operations.

The discovery was credited to Dr. James T. Gwathmey.

The anaesthetic is administered by an apparatus consisting of three glass bottles with one stop cock. One bottle holds ether, another chloroform, and the third water warmed a few degrees higher than the temperature of the blood. By means of a foot pump the vapor is made to bubble through the water before it is administered. The newspaper account presented the facts in such a way as to lead one to infer that the discovery is radically new and marked a great advance in the method of administering anaesthetics. We have taken the trouble to ask surgeons connected with the leading hospitals of New York city for their comments on the process. With one accord, they stated that the method was several years old and generally well known.



Making the Starting Crank Obsolete

By H. P. Wilkin

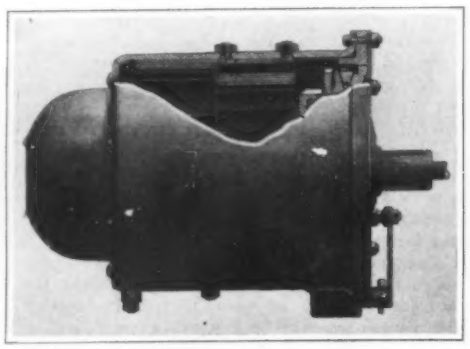
THE majority of leading motor car manufacturers have adopted automatic starters for their 1912 or 1913 models, and specialty companies are in the market with self-starters of half a dozen or more distinct types. Inasmuch as most of these are quite new and almost unknown to motorists in general, an attempt will be made to present briefly their different characteristics and methods of operation.

The reputation of one of the real pioneer automobile companies is staked on the success of the air pressure type and another company almost as old and with a very large annual output of cars has indicated equal confidence in the electric system.

In their main features the pneumatic starters are so much alike that one description will fit all except for minor constructional differences. The initial movement of the pistons necessary to create suction and compression in one or more of the cylinders is effected by the expansion of compressed air. This is admitted first to that cylinder in which the piston is on the explosion or working stroke. The pressure, which may be from 20 to 150 pounds or more per square inch, pushes this piston down, thereby causing the piston that is on the suction stroke to draw in a charge of fresh gas from the carbureter. At the end of the stroke the pressure is automatically transferred by means of a distributor or selector to the second piston ready for the working stroke, and as this descends it raises the one that was previously on the suction stroke and compresses the fresh charge, which is fired automatically by the regular ignition system when compression is completed. The engine is then ready to run on its own power, and the starter can be shut off. But if the engine fails to start on the first or second turn, the crankshaft can be revolved a large number of times before the air pressure is exhausted. With some systems the engine can be started 100 times, it is said, without renewing the pressure.

Only the pressure of a foot button or push valve on the dash is needed to start the engine with this system; everything else is automatic. The shock of starting "on the spark" is avoided because, as in hand cranking, the reciprocating and rotating parts are set in motion gently by the air pressure before ignition of the first charge occurs. Operation is practically noiseless and, if the air passages are large, the action should be fast enough to insure ignition with a battery. One manufacturer asserts that the only time when it will fail to start an engine that is properly adjusted and in good running condition is when the crankshaft stops on a dead center. This does not occur often with the ordinary four-cylinder engine and cannot happen with six-cylinder engines.

The mechanism employed consists of a compressor driven by the engine, a pressure tank carried under the car, a pressure gage on the dash, a push valve on the dash or footboard, a distributor or selector driven by the engine, air valves opening into the combustion chambers of the cylinders and the necessary copper piping and brass unions to connect these elements in the proper way.



Typical spring starter.

Broken away to show double spring and brake clutch.

Usually the compressor is a small air-cooled or water-cooled cylinder with a double piston so attached to the head of one of the engine cylinders that its lower barrel communicates with the combustion chamber while the upper barrel has a small valve opening to the atmosphere. When the engine is running, each explosion in that cylinder produces an impulse of the plunger in the compressor and causes the chamber communicating with the atmosphere to compress a small quantity of air and force it through a tube to the storage tank. From five to ten minutes suffices to fill the tank, and when a predetermined pressure has been attained—say 150 to 175 pounds—the back pressure automatically stops the operation of the compressor until the pressure has been reduced. The pressure is indicated at all times by the gage on the dash and should be maintained preferably at 60 pounds or more, although it is possible to start the engine with as little as 20 pounds.

When the push button in front of the driver is pressed to start the engine, it releases some of the air from the tank and this passes to the distributor, whose function is to admit the air only to the cylinder that is on the working stroke, thus preventing the starter from working against compression. The device consists of a rotating metal disk or a sleeve having a slot that uncovers openings to tubes leading to the several cylinders in the order of their firing. It is geared to the cam shaft or magneto shaft so that it operates in perfect time with the engine. It runs continuously and necessarily stops, when the engine stops, in such position that the slot uncovers the opening that leads to that cylinder whose piston has last completed the compression stroke. As the crankshaft revolves under the pressure, the distributor uncovers the pipe to the next cylinder in order of firing and so on until ignition occurs and the engine begins to run on gas.

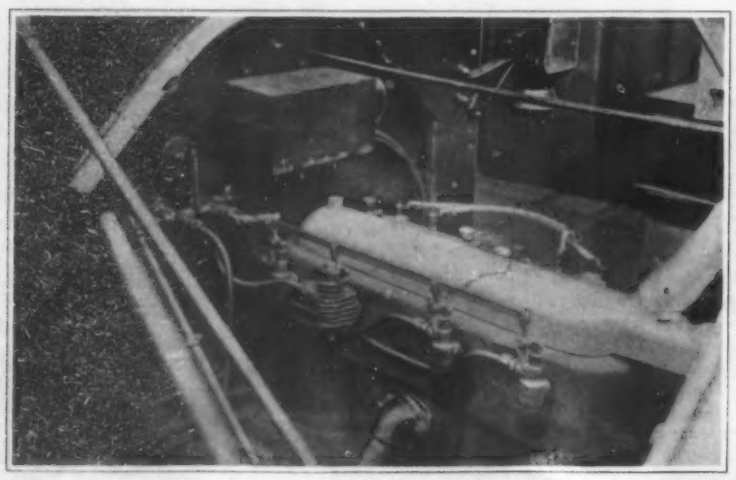
To prevent back pressure in the air pipes on the explosion strokes and consequent loss of power in the engine, a valve is introduced where each tube is connected to its cylinder. These valves are held closed normally by springs, but are all opened simultaneously by a buss bar or rod that connects them together and extends back to the push on the dash so that the same pressure that releases the air also opens the valves to admit it freely to the cylinders. The valves close automatically when the push is released.

Use of this system on a car obviates the necessity of providing a power tire pump for inflating tires or expending energy and patience over a foot pump. A flexible hose with a tire valve connection at its free end and a stop cock at the other end where connection is made, can be attached to the compressed air tank to be used for inflating tires, as is done by one of the motor car makers.

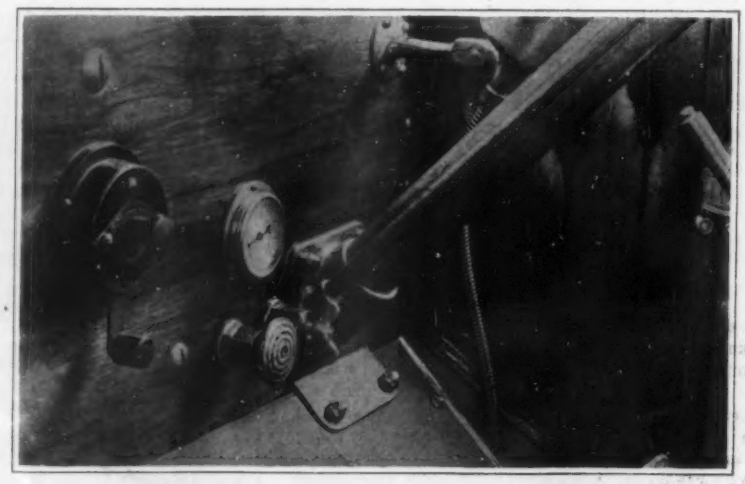
Electric starters are of an importance hardly secondary to the pneumatic type, because of the extent to which electricity is now being used on motor cars and the ingenious combinations that can be made of the

Automatic electric system applied to base of engine.

The starting pinion in mesh with gear on flywheel beyond which are cup and cone clutch and flyball governor.

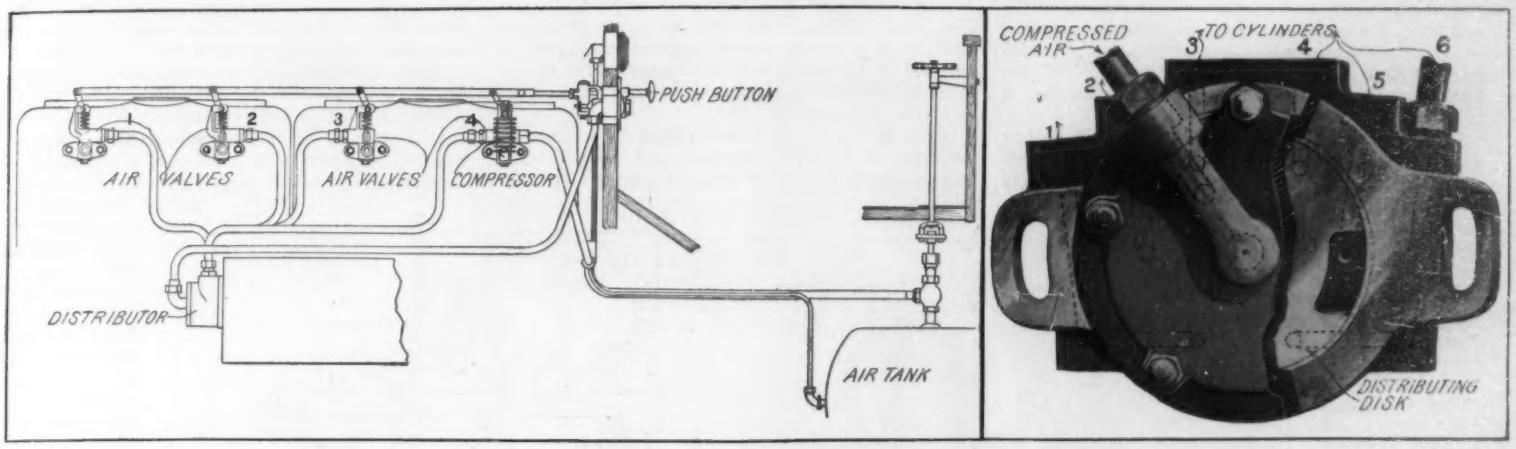


Engine with air compressor and air valve attached.



Rear of dash, showing pressure gage and foot push for starter.

ABOLISHING THE STARTING CRANK



Diagrammatic view of a typical compressed air system. The distributor for a six-cylinder engine is shown in detail.

The slot in the distributing disk successively uncovers ports leading to the cylinders admitting compressed air from the tank. The tank is charged by compressor on cylinder 4 in the diagram.

electric starter with the ignition and lighting systems. The placing in the market of this type of automatic starter by two well-known automobile electric specialty companies and its adoption as a standard equipment by one of the oldest and largest automobile producing companies give reasonable assurance that the system has been worked out to a satisfactory state of efficiency and dependability.

Like the pneumatic starter, the electric starter sets the moving parts in motion before combustion begins. It is wholly automatic, and will start the most difficult engine in from 8 to 15 seconds—usually in one second. It is certain in action regardless of the position in which the crankshaft stops and, by a combination of functions, does not add greatly to the weight and complication of an electrically lighted car.

The heart of the system is a compound-wound motor generator that takes the place of the generator used for producing the lighting current. This machine is so wound and connected up that it can be operated as a shunt dynamo for charging a storage battery or as a series motor for starting the engine, utilizing the current discharged back into it by the battery.

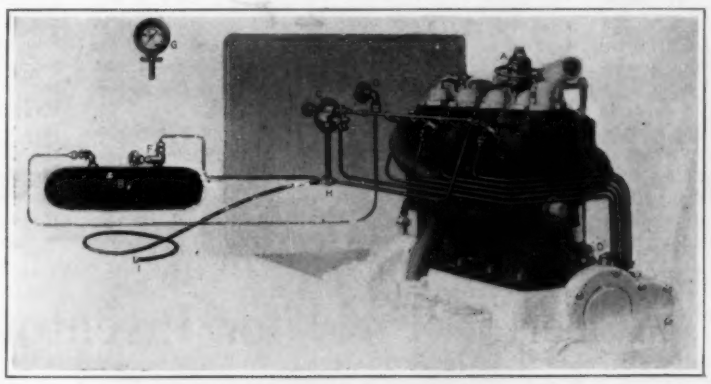
The motor generator is attached rigidly to the engine base and coupled to the magneto shaft or geared to a gear ring on the flywheel so as to be driven by the engine. One make is driven at engine speed; the other at practically constant speed whether the car is running ten miles an hour or sixty, a little ball governor and cone clutch regulating the speed of the armature shaft.

The storage battery is carried on the running board and current is taken from it to run the lamps on the car, and for ignition in the engine until the generator is running at sufficient speed to generate a current strong enough for ignition. In the circuit between battery and generator of one system is an automatic magnetic cut-out that stops further charging when the full capacity of the storage cells has been reached.

To use the generator for starting the engine, the process is reversed, the movement of the ignition lever or pushing down of a foot lever on the footboards closing a circuit from the battery through series field windings and armature windings so as to convert the generator into a series motor. Torque sufficient to rotate the flywheel, and crankshaft of the engine is developed, and suction, compression and ignition follow, as in hand cranking. In one system, the same gear that drives the generator is used for turning the engine over, but in the other system a clutch disconnects the driving connection with the magneto shaft and establishes a connection between a sliding spur gear and corresponding teeth cut in the periphery of the flywheel.

In order to insure starting in the coldest weather, one inventor employs mechanism for raising the exhaust valves during the starting period so that the starter will not work against compression in all the cylinders, and also locates an electric vaporizing button inside the carbureter where it will heat up and instantly vaporize the gasoline. All operations are automatic, the only movements required of the operator being the switching on of the ignition current in the usual way and the setting of the spark lever to a position marked "start" when using one system or pressing the pedal when using the other. Raising the foot automatically opens the circuit to the vaporizing button, reseats the exhaust valves and closes the charging circuit between the battery and generator so that the latter once more becomes a shunt dynamo.

The electric systems operate on 16 and 24 volts. Charging begins at about 300 revolutions per minute of the engine, and is at the rate of 12 or 14 amperes in one system and 35 amperes at 2,500 revolutions per minute of the armature in the other. In one system the generator weighs 40 pounds and the battery 72 pounds. In the other the battery has a capacity of 80 ampere hours. Tests prove that the battery has capacity enough to turn the engine over for about twenty minutes at a rate of about 200 times a minute. Usually, however, the engine can be started in about one second, provided it is in good running condition.

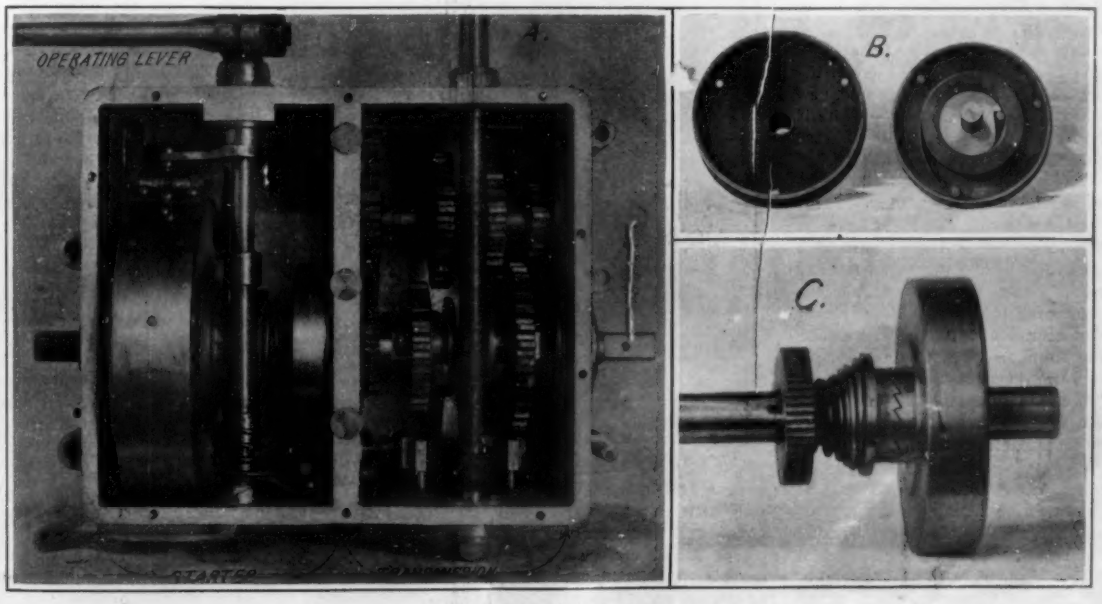


Automatic compressed air motor starter.

A, check valve; B, storage tank; C, dash push valve; D, distributor; E, cylinder valve; F, shut-off valve; G, pressure gage; H, tire inflator valve.

Among the automatic starters in the market are several distinct types that utilize explosive gasoline mixtures or acetylene gas in combination with the well-known method of starting on the spark. Two or three inventors introduce a rich gasoline mixture into the working cylinder by means of a hand pump attached within easy reach of the driver. The pump draws fuel from the gasoline tank and, mixing it with air in the most readily ignitable proportions, sends it under pressure through a selector to the cylinder in which ignition can occur first. A sufficient charge having been given the engine, it should start as soon as current is switched on. One maker employs a small electric blower to force the mixture to the cylinders, instead of a manually operated pump, driving the electric motor with current from the ignition battery and delivering the mixture to two cylinders at once without the use of a distributor. This necessitates a trial to determine which cylinder is on the working stroke, with a change to the alternative pair of cylinders if no explosion follows.

The acetylene gas starters depend upon the superior explosiveness of this gas for their success. In one system the gas tank is connected by a copper tube to a foot button which, upon being pressed, opens a valve and allows a small quantity of the lighting gas to escape into the intake manifold above the carbureter. An electric cut-out is also arranged to short circuit the ignition current when the button is depressed. To operate this system satisfactorily, it is essential to have an engine that holds compression well. When shutting off the engine to stop, the operator does so by plac-



Automatic spring starter.

A, general view; B, spring casing; C, spring, clutch, and pinion.

NEW AUTOMOBILE ACCESSORIES

ing his foot on the push button, thereby cutting out the ignition and allowing the cylinders to draw in charges of hydrocarbon gas containing a proportion of acetylene. Before raising the foot, he switches off the current at the dash so that to start again all that is required is to switch on the current.

Differing radically from all of the starting devices already described is a class of purely mechanical starters that includes several types. The more elaborate of these are the spring starters, which alone are automatic, while the simpler forms are those in which the starting effort is applied by the operator through a lever, pedal, or crank placed within convenient reach from the seat.

One of the newest spring starters stores up a part of the energy of momentum that otherwise goes to waste when the car is brought to a stop with the brakes, and releases that energy when the driver wishes to use it for restarting the engine. This device is preferably built into the transmission case in unit construction with the change speed gears. On the drive shaft is mounted a brake drum that contains a compound spring and is incircled by a brake band actuated by the regular engine clutch pedal. A separate pedal is used for releasing the tension of the springs.

In operation, when the car is stopped the action of declutching sets the brake band and holds the drum stationary, allowing the spring to be wound up by the action of the rear wheels, rear axle and transmission shaft. The spring is held against unwinding by a ratchet clutch until it is desired to restart the engine, even after the clutch has been set again. The gear shift lever being in neutral position, the spring is released by the small lever and, transmitting its tension through the car clutch, revolves the flywheel and so starts the engine.

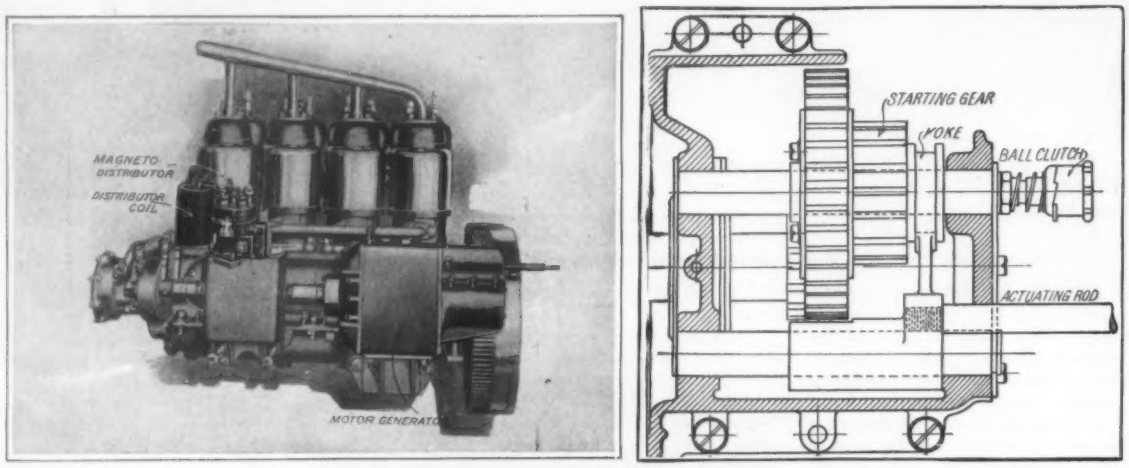
A peculiarity is that the spring is wound and unwound in the same direction, and, as no reverse motion occurs, the use of idlers and gears is avoided. The spring is so long that it is always under high tension and only about one-quarter of its stored energy is used at one time. The action is positive and the engine is given a number of quick revolutions—a matter of some importance in cold weather—the number depending upon the length of the spring.

This device weighs less than fifty pounds complete, and, as compared with the pneumatic and electric systems, the extra cost it adds to a car when supplied as regular equipment is small.

There is another type of spring starter that has been in the market for some years. Two strong springs inclosed in a heavy brass case attached to the front of the car are connected to the engine by a shaft and universal joint provided with a clutch mechanism. The springs are wound up by the engine when it is running under its own power, until the full tension has been reached, when they are automatically disconnected and held in tension. To restart the engine, the springs are released by means of a pedal that is connected with the brake band of the starter by a steel cable.

Although the manually operated mechanical starters are not automatic, they possess the virtue of not obliging the driver to leave his seat to start the engine. By suitable gear reduction they can also be made to require less physical strength than the ordinary starting crank.

One recently improved style has a clutch attachment that fits the front end of the crankshaft and is concealed in a brass casing which is supported by arms bolted at either end to the side frames of the car. The casing also carries a sprocket over which runs a chain. One end of the chain is secured to a revolving nut journaled on the outside of the right-hand frame member of the car. A long quick-pitch screw passes through this nut and is attached at its rear end to a side lever near the driver's seat. A backward pull on the lever rotates the nut and winds up the chain, turning the crankshaft. One pull suffices to revolve the shaft over one compression, and several pulls will spin the shaft and flywheel. As soon as the engine starts to run the starter is disengaged by centrifugal force.



Automatic electric starter employing a motor generator.

The generator when driven by the engine charges a storage battery. It runs as a motor on current from the battery to start the engine. The line drawing shows the reduction gearing and clutch of the motor generator.

A Fertile Field for Inventors

Opportunities Offered by the Automobile Industry

ANYONE who ever has stepped into a leading automobile supply house in one of the large cities and surveyed the goods displayed in the showcases and on the shelves and stands, must have formed the impression that every conceivable device of possible utility or comfort to the automobilist had been invented and put on the market. The last annual catalogue of one of the principal jobbing houses of automobile accessories in America contains an index of 685 different articles for the motor car trade that are illustrated and priced in the book of 144 pages. Another jobbing house, much longer established, issues a catalogue containing twice as many pages, and it is fairly safe to say that in round numbers 1,000 different articles are to be found between its covers.

All of these goods have been invented and marketed during the last fifteen years, and most of them in the last decade. Motoring was such an altogether new method of transportation and the automobile itself such a radically different sort of vehicle from all that the world had known before, that when thousands of minds were turned in this direction almost innumerable ideas suggested themselves for adding to the safety, convenience, and comfort of the motorist.

The readiness with which wealthy buyers paid high prices for automobiles in the earlier days and for any article of equipment that struck their fancy made the invention and manufacture of such devices highly profitable. Some very comfortable fortunes undoubtedly have been made in a few years in this field. Several devices that have brought immense returns in proportion to the capital invested are the tire-chain, the speedometer, shock absorber, carbureter, gas tank, detachable and removable rims, magneto, and so on.

Quick success has been so pronounced in the case of many automobile accessories, or more correctly, appurtenances, that it has been easy to enlist the backing of ample capital for a new invention of obvious merit as compared with other and more settled fields of manufacture. Success has not been confined to enterprises financed by large capitalists. Many a poor repair man and machinist has already won a competence and an enviable position in the industry by his ingenuity and persistence in getting his inventions before the motoring fraternity. While this has been most pronounced in the cases of designers capable of laying down the working drawings for a complete car, some of the most successful inventions have been the simplest. A spark plug, a brake lining, an anti-skid device, a tire repair sleeve, a pair of good goggles, an adjustable mirror for looking back, or a spring bumper may be more profitable proportionately than a magneto, a transmission, a motor, or a rear axle. Often very little capital is needed to start manufacture, and if the device has real merit and utility, the orders received for it can be used to secure more capital to carry on the business and expand it rapidly. This is, of course, an old story in the automobile industry.

Fig. 1.—Pedals adjustable for short and tall operators.

Not all inventions are successful, by any means. The *Patent Office Gazette* bulges with the descriptions of inventions that never have been seen in the market, and the short but eventful history of the motor car business has its records of commercial failures of a good many devices whose mechanical efficiency or appeal to automobilists was misjudged by the inventors or backers.

Two of the worst pitfalls of the inventor have been tires and wheels. Because the pneumatic tire has been confessedly the weak spot in motoring, about nine out of ten men occupying a plane of intelligence above that of the ordinary day laborer have tried to invent a substitute for the pneumatic tire. To hundreds the spring wheel or pneumatic hub has suggested itself as the most feasible solution. But if the fact is considered that it was the pneumatic tire that made the automobile even possible and the further fact that despite all the gray matter and Patent Office labor that have been expended in this direction practically every pleasure automobile in use to-day, after fifteen years' existence of the automobile in America, runs on pneumatic tires, the advice to leave the pneumatic tire and the rigid wood wheel alone should sound reasonably friendly and sage.

While it is true that the market seems to offer every device that is needed, there yet remain many opportunities to produce new inventions and to make important improvements upon old ones. The industry has only just reached its prime, and the last year has been about as productive of new devices as any in the past; in fact, the number of inventions and patents has increased rapidly each year up to the present. A regularly increasing proportion, however, relate to improvements in existing devices or to imitations of successful articles already on the market. Strictly new accessories are becoming somewhat rare. Nevertheless, large financial rewards await the inventor and manufacturer of numerous other meritorious devices. A simple and effective smoke arrester that would not set up back pressure would doubtless be appreciated in cities where excessive use of oil may subject the driver to arrest and fine. Hub caps are susceptible of much improvement; in their exposed position they are knocked off frequently, the threads wear, and it becomes impossible to keep them in place except by some unsightly make-shift of tying them on or fas-

tening with improvised metal straps. As a rule the caps are made of brass or aluminium or other soft metal, not very thick and threaded internally with a rather fine thread to screw upon the end of the steel hub of the wheel. Surely the inventor can evolve a secure fastening or a way to dispense with the hub cap altogether.

Until all men grow to the same stature a very large number will find an uncomfortable relation between the driver's seat of an automobile and the steering wheel, pedals and hand levers, because the user's legs and arms are either too long or too short. There appears to be a need for an adjustable driver's seat which can be elevated and lowered, moved forward and back, and whose angle of inclination can be changed at will. Office chairs are so made and every bicycle, no matter how cheap, has adjustable handlebars and seat; yet in the costly automobile the relation between the seat and control mechanism is fixed unalterably, much to the inconvenience and awkward appearance of the very tall man and the very short one.

A simple, comparatively inexpensive yet effective self-starter for motors is being sought for more to-day than ever, and one that commends itself to manufacturers and motorists will surely have a wide adoption. Next to the automatic starting device, the most desirable thing is a safety starting crank that will obviate all danger from back-kick. Several such cranks have been brought out recently, but as every car might be equipped with one, there is a potential market for upward of half a million, which almost certainly never will be filled by one make.

Undoubtedly it would be a great convenience at times if the fenders could be detached quickly and easily to enable the driver or mechanic to get closer to the engine or to work more conveniently around or behind one of the wheels. Inventors might devise a substantial bracket and socket with a cam lock so that the simple movement of a little lever would release the fastening and allow the fender to be lifted off.

Counting every separate bolt and nut, there are approximately 5,000 separate parts in a high-grade automobile. In the less expensive cars the tendency is to diminish the number as much as possible, which is accomplished by combining several parts in one, as in the *bloc* type motor, which has the four cylinders, water jacket, intake manifold, and exhaust manifold made in a single casting. This simplification process can be carried out, no doubt, in other parts of the machine.

The following examples of new inventions, perfected and recently placed on the market, will serve to show the directions in which inventive genius and designing skill are being exercised, and may afford suggestions for other desirable accessories or motor car improvements.

The adjustable pedals shown in Fig. 1 are an improvement that will be found in the 1912 model of one of the oldest and best known makers of cars in America. The foot plates have stems that are notched transversely on the under side and slide into the hollow clutch and brake levers. Bolts passing through lugs on the ends of the levers engage any of the notches desired, securing the foot plates in any adjustment to accommodate them to the legs of short or tall operators.

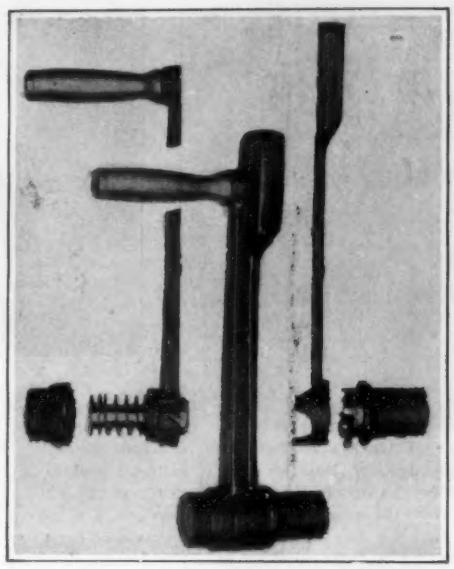


Fig. 2.—Anti-kick starting crank.

Fig. 3.—Tire pressure gage.

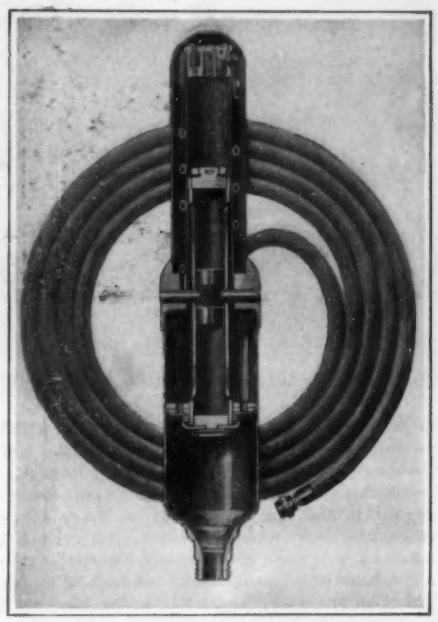


Fig. 4.—Power-driven tire pump.

A recently introduced safety starting crank illustrated in Fig. 2 fits any motor and is operated like the ordinary crank. The arm of the crank is made in two parts held together at the shaft end by a compound or two-way clutch and a stiff coil spring. In case of a back-kick the sudden reverse impulse, resisted by the inertia of the weighted arm, disengages the clutch, and the handle grasped by the operator is practically unaffected. The weighted arm has a movement of only about an inch and the action is so sudden that it is almost imperceptible.

Another new safety crank brought out during the past summer is made with a friction joint similar to the spring spider and friction plates of a well-known shock absorber. In a housing at the shaft end is a train of reduction gears which makes it unnecessary to exert much pull on the handle, the gears serving to multiply the power at the end of the crankshaft. The friction device suffices to hold the crank against the moderate effort applied, but when a back-kick occurs, a spring pawl and ratchet hold the handle against flying backward while the friction plates slip and absorb all the shock. With this geared-down starting crank the effort required to start the largest engine is said to be scarcely more than that of winding a phonograph.

There never was any danger of over-inflating an automobile tire with the old bicycle type foot pump, but with power pumps coming into common use there is such a possibility. Under-inflation is still a far more likely fault, however. To prevent both and thereby prolong the life of tires, several makes of tire pressure gages are offered to the motorist. The type illustrated in Fig. 3, partly in section, is about the size of a fountain pen and is intended to be held in the hand and applied at one end to the tire valve. A small volume of air released from the tire enters the inner tube of the gage and forces it upward against the tension of the coiled piano wire spring contained within it. As this tube moves, a pair of pins in its upward end which project through slots in the sides of the outer case, slide the indicating ring along the scale. When the gage is removed from the valve the inner tube is retracted by the spring, but the ring remains stationary, and the amount of pressure is indicated in pounds per square inch by the figures on the scale at the top of the ring.

A new inflator presenting some features of special interest is shown in vertical cross-section in Fig. 4. The shell is threaded externally at the lower end to be screwed in place of a spark plug in the head of one of the cylinders. When the motor is run on the remaining cylinders, the compression in the first cylinder drives the double-ended piston upward until it is checked by a cushion of air under the wrist-pin extending through the central casting. During this movement, air contained in the upper chamber of the inner shell is compressed and forced out at the top through a small valve on the right into a metal tube wound spirally between the inner and outer shells and communicating through the central casting with the rubber hose. The hose has a valve connection and is long enough to reach to either of the rear wheels. During the suction stroke of the motor piston, the inflator piston is drawn down and draws a charge of

(Continued on page 29.)

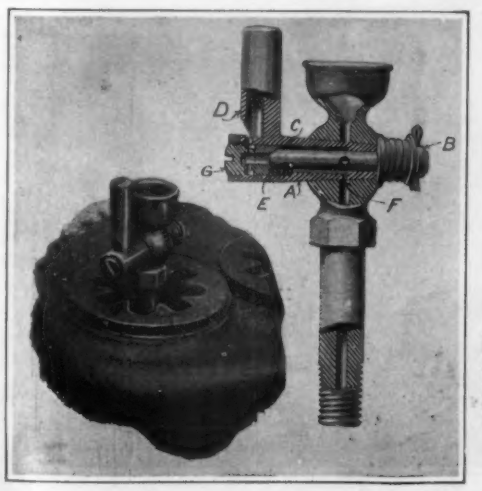


Fig. 5.—An over-heat alarm.

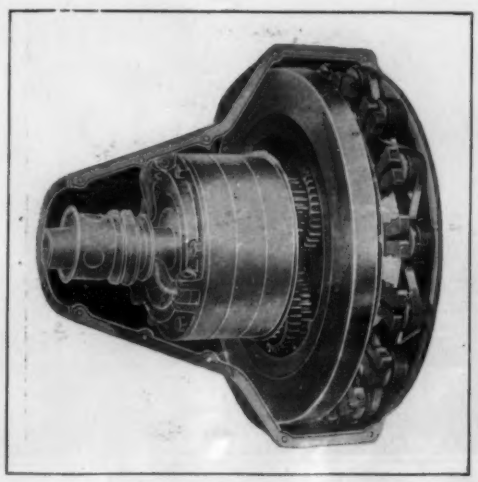


Fig. 6.—Flywheel magneto.

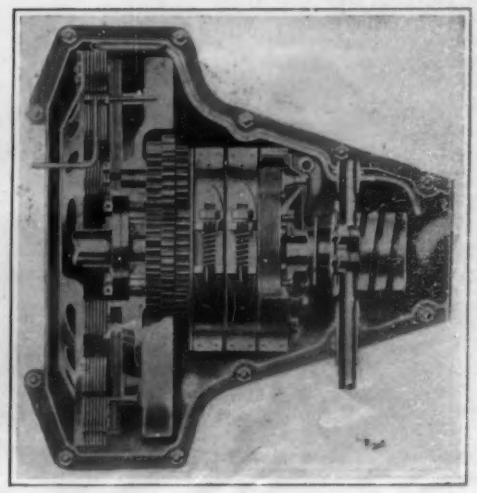


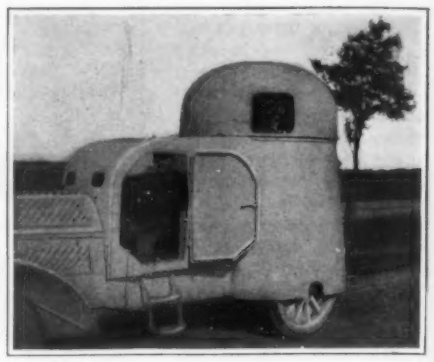
Fig. 7.—Cross-section of the magneto.

NEW ACCESSORIES FOR THE AUTOMOBILE

Gasoline in War

How Europe is Creating an Army by Subsidizing Motor Vehicles

By Theodore M. Raulein von Keler



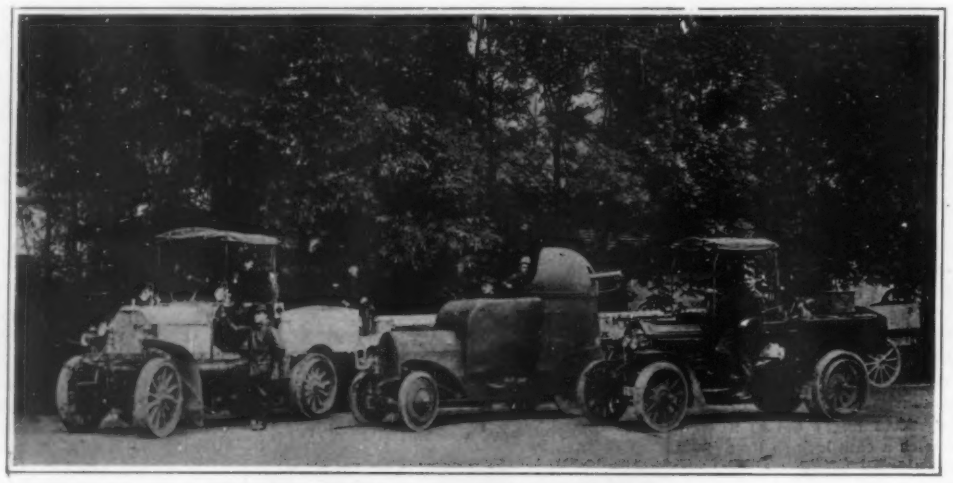
WHILE the members of the United States Government and Congress are still wrangling with the problem of ship subsidies, the various continental European nations are continuously and assiduously extending their plans of government control by means of subsidies over nearly all forms and kinds of power transportation. Not satisfied with the establishment of strong mercantile navies, which in time of war may prove of vital importance in the transporting of large bodies of troops across the intervening seas, Germany, France, Russia, and Austria are working at present upon a gigantic scheme of obtaining at least partial control of every vehicle, whether horse-drawn or motor-propelled, within the confines of their respective boundaries. And the word "vehicle" is here used in the very widest possible sense, including all manner of wagons, road trains, railways, motorcycles and even aeroplanes and dirigible balloons.

Owing to the very recent development of aerial vehicles as factors in commercial and military transportation problems, the regulations necessary for a proper and just subsidy of scouting aeroplanes and passenger-carrying balloons have not yet been reduced to a workable basis; but in the matter of controlling gasoline-driven vehicles running upon *terra firma* the system has been brought down to a fine point. It provides in its book of rules for nearly every contingency that may arise.

It is not generally known that practically every automobile running in the German Empire may be requisitioned by the government in time of war, subject, of course, to a sort of indemnity payable to the owner. But in the case of the motor truck and the motorcycle the government has seen fit to grant annual subsidies and to establish a volunteer corps which may be called into active service at any moment. How the system works, and its enormous efficiency in time of war is not generally appreciated here in America.

Particularly in the matter of truck subsidies, the German and French governments have been at great pains to evolve the most efficient transportation system ever dreamed of. In former wars the question of transporting the provisions for a big army has been of more importance than that of getting a large number of heavy cannon to a certain predetermined place at a certain predetermined moment. The failure of the guns to arrive at the proper time might at the worst result in the loss of a battle or part of a battle; it might be the cause of thousands of deaths from the unchecked fire from the enemy; but the failure of the train of provisions to arrive at the end of a day's march, or to keep with the marching troops at all times, would have resulted in the rout and defeat of the whole army, not by fire from the enemy, but by hunger and weakness. In the wars of the future, owing to the far larger units to be transported, the great distances covered in shorter time, the moving of the provision train at a speed equal to or even greater than that of the main body of the army is a problem at once difficult and pressing. There are only two means of locomotion in existence at present, which would fulfil these demands to satisfaction, and they are: An efficient railroad service and a fleet of high-class, powerful motor trucks. Evidently the use of the railway is confined to the routes which follow the rails; and it becomes of very problematical value in the country of the enemy. There remains, therefore, only the motor truck as a factor worthy of consideration.

A modern motor truck capable of fulfilling the rigorous demands of active war duty must naturally be a vehicle of more than ordinary construction. In the discharge of its duties in maneuvers and in actual war the motor truck, or complete "road train" is called upon to accomplish work which never would be demanded of it in every-day commercial service. In the first place, the weight of a complete road train with its full complement of driver, helper, gasoline tanks, winches and tools, is almost ten tons. In addition to moving this tremendous dead weight the motor truck with its trailer—the two composing a "road train"—must be capable of carrying a useful load of at least 13,000 pounds. These weight requirements are one of the first essentials demanded by the German government in its subsidy agreement. What is a truck subsidy? It is a sum of money paid annually by the government to the owner or operator of a motor truck under certain conditions. These payments are intended to assist merchants and manufacturers in changing from horse-drawn to motor-propelled service wagons, under the correct presumption that a motor truck would prove of incalculable benefit to a company or battalion of soldiers on the march. But in order to earn this subsidy the truck owner must conform to various regulations and go through a good deal of red tape.



Group of Austrian war automobiles of various types.

Automobile hauling a Blériot monoplane in the recent French maneuvers.

The German government, in formulating its rules for the granting of subsidies for road trains, took as a working basis a series of experiments conducted under army supervision, combined the results of these experiences with others obtained in the French subsidy trials and then made up its own set of requirements.

A road train, in order to be eligible to subsidies from the government, must consist of one motor truck and one trailer; it must at all times be kept in good condition and must be always at the command of the government ready for road duty in either war or maneuvers at a moment's notice. Loaded to the limit with provisions for the fighting hosts many miles away, the road train must be capable of making ten miles an hour over level roads, although it is not supposed to be driven at more than eight miles an hour over ordinary roads under ordinary circumstances. It must climb grades of 14 per cent without stalling the motor, and it must be strongly built so as to support the addition of a second trailer loaded with 4,000 pounds, should emergency require it.

Mechanically considered, the motor must be so constructed as to allow the use of either gasoline, benzine, benzol or alcohol. It is not necessary that it be of any particular type of internal combustion engine, save that it must be of standard pattern, well tried out, with no less than four cylinders, sparked by magneto ignition and fitted with a reserve battery. In other respects no limitations are placed upon the designing ability or ingenuity of the manufacturer; on the contrary, special awards are made to manufacturers or employees who design or invent some new plan or improvement by means of which the efficiency of the truck for military purposes is increased. When a German manufacturer or dealer purchases a motor truck which he desires to operate under a subsidy arrangement, he notifies the government of his intention and the truck with its trailer is subjected to a most rigid examination by government experts. Such an examination, of course, is very valuable to the purchaser as it assures him in regard to the efficiency, power, careful construction, etc., of the vehicle, which otherwise he would have to take on trust, at least to a certain extent. As soon as the government officials have decided that the road train meets all the military requirements as to structural strength and loading capacity, the purchaser is given the sum of $1,000 toward the purchase money. He thereupon signs an agreement with the government in which he promises a good many things in exchange for financial assistance during the five years of active service which the average motor truck is supposed to render, before becoming ineligible for further road duty in war and maneuver.

In the first place, he must promise to handle this road train very carefully during the time of the agreement; he must take out an insurance policy for the full amount against fire and accident; he must agree not to sell this subsidized train to any person who is not a citizen of Germany, having his permanent residence within the realm of the Kaiser, without first obtaining the government's permission to do so, and under no circumstances must he permit a subsidized road train to cross the frontier into any of the neighboring States. He must at all times allow the agents of the government to examine the truck and trailer as to their condition and road efficiency, and must submit every three months a detailed report in tabular form, giving the work done by the truck, the loads carried, roads traversed, quantity and price of gasoline and oil used during that time, the character of all repairs and replacements made since filing his last report, and all other matter concerning the upkeep and operation of the road train. Should he fail to fulfill any of these requirements in any one particular, a fine of $125 is imposed. A repetition of the offense usually carries with it the loss of the subsidy and cancelling of the contract. Twice each year the owner must send his trucks on a reliability tour under the supervision of the government and at the latter's expense; in case his vehicles do not fully measure up to the requirements his annual subsidy is immediately stopped. This annual subsidy begins with the end of the second year, when a sum of $250 is paid to the owner, and is repeated at the end of every succeeding year until four instalments have been paid, or, in other words, until the owner of the road train has received the sum of $2,000 as government assistance. No subsidy or assistance of any kind is given to trucks that have been in service for more than five years.

An armed and armored motor vehicle.

According to careful compilations made during the last few months, there are at present no less than 800 subsidized road trains at the beck and call of the German War Department, and it is easy to understand what an immense help this motor fleet of powerful vehicles would prove in actual war. Austria, Russia, and particularly France, have not been blind to these advantages and have inaugurated truck subsidy systems based on the German plan, so that wars of the future will see the majority of horses displaced by the far more efficient truck, propelled by a powerful, never-tiring gasoline motor. But this is not all. Not satisfied with creating such an immense caravan of gasoline-driven road vehicles, for the transport of ammunition and provisions, the War Department has made extensive use of the subsidy plan in establishing an auxiliary motorcycle courier corps, the so-called *Schnellfahrer*.

The system is very similar to that in use regarding the trucks. Young men who already own motorcycles, or who desire to become couriers may make application to the government and become enlisted as *Schnellfahrer* (fast riders). During maneuver time a certain number of these couriers are ordered to present themselves with their machines at headquarters and are temporarily enrolled as soldiers. They are under strict military discipline, receive military fare, khaki uniforms, and $2.50 per day. They are used for carrying dispatches, for reconnoitering and for similar duties where speed is a chief factor. During the time of such maneuvers and, of course, in actual war these *Schnellfahrer* have the absolute right of way on all highways; they are responsible only to the military authorities and are not subject to speed regulations; they may go at 90 miles an hour over the hard, straight roads of Germany without running the risk of arrest and fine. Should they suffer an accident the injured rider is taken care of in a field hospital or carried to the nearest city, while the machine is repaired at government expense. Should repairs be impossible the rider receives a new machine, and should he be crippled or otherwise seriously injured a government pension is granted. Every member of the *Schnellfahrer* corps is protected against discharge from his position for partaking in the maneuvers, and the government's severest displeasure is visited upon any employer who should dare discharge one of them for that reason. Over 2,000 *Schnellfahrer* obeyed the call of the government during the past summer maneuvers, and the wonderful speed and efficiency of this corps created a furore in the Fatherland.

In the case of mobilization the *Schnellfahrer* must immediately surrender themselves and their machines at the nearest military depot, which will indemnify them to the full value of the machines when new. It is provided in the agreement between the government and *Schnellfahrer* that the machine he rides must be kept in first-class condition at all times, and a fine is provided for any violation of this rule. In order to supervise this corps, the government has appointed ten motorcycling petty officers, whose sole duty it is to make a round of the military depots and

(Continued on page 30.)

Reliability test under army supervision.

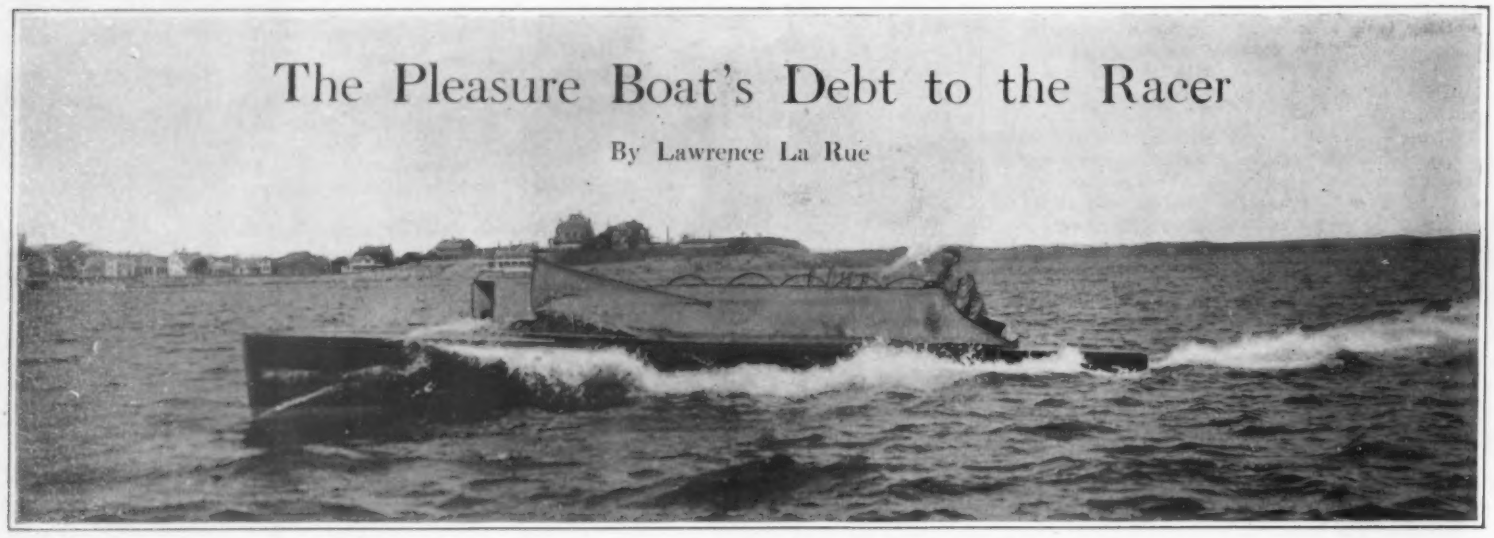
Motor truck commandeered by the French army.

Armored automobile for fighting aerial craft.
Note the cellular ammunition magazine.

GASOLINE IN WAR

The Pleasure Boat's Debt to the Racer

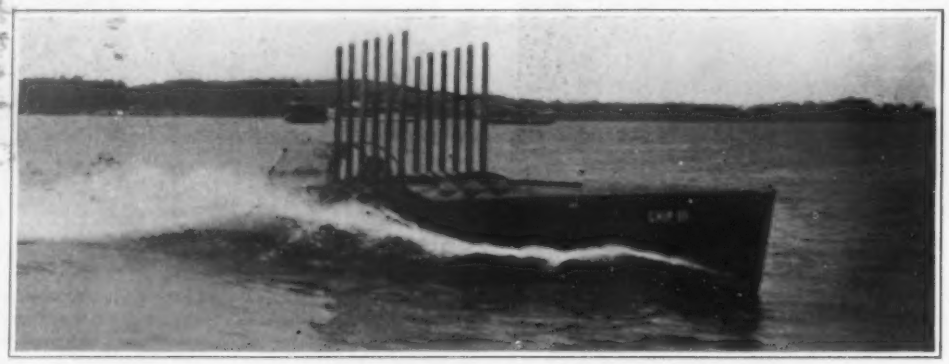
By Lawrence La Rue



Photograph taken at the instant that a "back-draught" blew a puff of gas in the steersman's face.

A MOTOR boat built for racing purposes only may well be called a "rich man's toy," for a 40-foot craft of this type will cost from ten thousand to fifty thousand dollars, and yet will be unable to accommodate more than three or four persons comfortably. It will be so delicate and "high-strung" that it will be practically unsuited for pleasure purposes, and its career as a local, national, or international champion may be so short-lived that, in a few seasons, there may be nothing to show for the immense original outlay but a high-powered engine and a delicate, unsubstantial hull. Of course, there are *bona fide* pleasure boats capable of attaining a high speed, but these are not racers in the strictest sense of the word.

But motor-boat racing is an alluring and fascinating sport, and has probably done more to develop the art of hull and engine design than any other phase of motor-boat engineering, and even the man in his little sixteen-foot, one-hundred-and-fifty-dollar "runabout" may thank the millionaires who have made these experiments in high speed possible. For, as a result of combinations of high power and delicate hulls, lessons have been learned that can be applied to every size and type of motor boat; for racing represents only the extreme of some of the problems that are met with every time we try to move a floating body through the water.



Racing boats bristle with exhaust pipes.

The hydroplane seems destined to be crowned the speed queen of the water, for in all of the recent races of note, it has been this type of boat that has carried off the honors. But as it is still the displacement boat that is used for pleasure purposes, and as it is the factors affecting the speed of his own type of craft that will interest the average motor-boat owner, a detailed consideration of the hydroplane will not fall within the province of this discussion.

Although power is generally supposed to be the deciding factor in the attainment of speed, it must be used with discretion; for each hull has a limit above which it cannot be driven—no matter how great an addition may be made to its power plant. Thus, in many instances, the substitution of a larger motor or an increase in the number of cylinders represents an absolute waste of power; and in such cases, it is probable that a change in the length of the hull will do more toward obtaining the desired speed than would doubling the size of the engine. In general, it may be said that the greater the waterline length of hull (within certain limits) for a given beam, the greater will be the speed of that boat, and, conversely, that the speed decreases with the increase in beam. A motor boat must be of a certain beam, however, in order to carry the weight of the engine and remain on an even keel in rough weather; and in consequnce of this and other factors deciding the dimensions of hulls, the "mile-a-foot" displacement boat was indeed a wonder a few years ago. By "mile a foot" is meant a speed of a mile an hour for each foot of waterline length. When it is remembered that the only displacement boats ever attaining a speed of over 40 miles per hour were at least 110 feet long, it may be realized that the "mile-a-foot" boat marked an epoch in hull and motor construction. There are now several 16-foot boats capable of making 18 miles an hour, and some 19-foot hulls that can attain a speed better than 20 miles an hour. But such craft are still rare enough to represent a decided triumph for designer and builder of both hull and motor. The case of the hydroplane is different, however, for craft of this type having a waterline length of less than 30 feet have succeeded in attaining speeds greater than 40 miles per hour.

The resistance to the passage of a displacement boat through the water is considered to increase as the square of the speed, while the horse-power varies as the cube of the speed. These are statements which may explain why some boats may show but a mile or so an hour more speed after a hundred per cent addition to the power plant. The fact that a hull changes its position in the water as the speed increases, and that, in consequence, a boat may almost "smother" itself if pushed too far, makes a more or less definite limit beyond which a craft cannot be driven. The utter uselessness of too much power was well exemplified in the case of a racing boat which, in her day, was considered a wonder. This boat was equipped with a 48-horse-power motor that served to drive her at a 24-mile clip—championship speed a few years ago—but her owner was ambitious, and desired to increase her rate of travel to the 30-mile notch. Accordingly he replaced her old motor with one developing 150 horse-power—and obtained one mile an hour increase in speed! The motor was never allowed to develop its full power, for aside from the excessive vibrations that would certainly have shaken the whole frame to pieces, at 25 miles an hour the stern drew down in the water to such an extent that there was danger of this half being entirely submerged should the speed be increased beyond this point. The boat in question, once the pride of her day, is now crowning a junk heap, a monument to the desire for speed without reason.

Another popular superstitition held by many motor boatmen is that a boat capable of attaining high speed on fresh water will be much faster on salt water. This is true to a very slight extent, for the salt water, being heavier, allows the hull to travel more nearly on its surface, but the difference is so small as to be almost negligible; for the respective speeds in salt and fresh water bear the ratio of 5.66 to 5.5. While light weight of the hull and power plant is desirable for the attainment of high speed, this is another feature of design which can be carried to extremes. It is far better to err on the side of safety, and to employ planking that is too thick than to be beset with the troubles to which some of the "thin-skinned" boats are heir. When he sits at the wheel of his 100-horse-power, 40-foot racer, or crouches in the bottom to escape the breaking waves, the owner may be separated from the water by a thin, wooden shell but 3/16 of an inch thick; so thin is the planking often used in the construction of speed hulls of this size. While extremely light hulls may be suitable for calm weather, and may even succeed in winning races on rough days, an accident that happened to one of them illustrates the unexpected results that may follow radicalism in the design of any motor boat.

The craft in question had been built for one of the best-known designers of the country, and had exceeded all expectations as to speed. The hull, however, had evidently been constructed of such light material that it could not withstand the pounding to which it was subjected in a heavy sea. While racing one rough day, the boat successfully mounted the crest of a wave, hung there an instant—and then broke in

Smothered in a fog of spray.

two in the middle, almost as cleanly as though it had been severed with a knife! The portion of the hull containing the motor had evidently been unsupported by the water when the craft rose to the top of the wave, and the strain caused by the weight of the power plant had proved too much for the light construction.

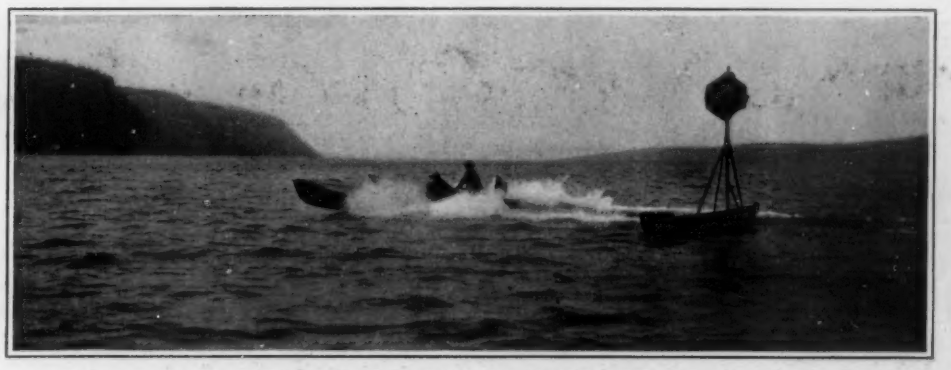
Perhaps an idea of the extreme lightness of some hulls in proportion to the power they are to carry can be gained from the statement that some craft of this character have a decided list to starboard or port, depending upon the direction in which the motor turns. In order to overcome this, the hulls are either counterbalanced or designed with a list to the opposite side, so that the boat will run upon an even keel when under full power.

It is impossible to foretell just how a new model will travel through the water at various speeds until it has been tested, and even the effect of a change in the power plant or design of an old hull cannot be determined with any degree of accuracy prior to its trial. It would, of course, be expensive to rebuild or discard each hull that did not give the desired results, and in consequence efforts are made to ascertain the behavior of each proposed model or change under different conditions before the final designs are decided upon. A small model is made, having the same shape, outlines, and proportional dimensions as those of the hull whose performance it is desired to test. This model is placed in a testing tank, and is drawn through at various speeds by a motor to which is attached an instrument showing the tension on the pulling cord. From the readings of the instrument and speed of the model, the power required to force the large counterpart through the water at the desired speed can be computed, for there is a relation between the size and speed of these two hulls of the same design. In other words, the behavior of the large hull under different speeds can be foretold by observations of the performance of the model under corresponding speeds in the tank, and by thus experimenting with the model, the proper design of hull for the required purpose can be obtained.

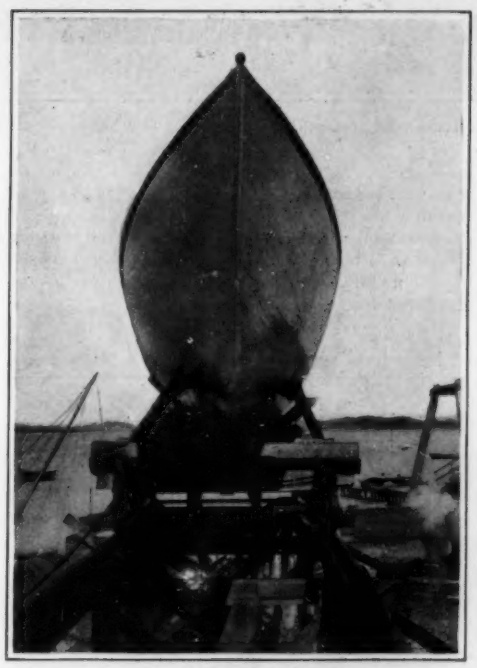
Experiments with models of some of the fastest racing motor boats of the day have brought to light some peculiar and interesting facts. For instance, it was developed in a test that an increase in speed of five miles an hour of one of the famous racers would cause a peculiar spurt, or stream, of water to be formed at the stern, although no vestige of this stream had been in evidence at the highest speed she was capable of attaining. This stream made by the model at the higher speed was of such a peculiar formation that it doubled back on itself and deluged the stern of the cockpit, and this was taken as sufficient evidence by her builders that the boat in question could not be pushed to this speed without being swamped in her own wake, as it were. Thus months of useless experimenting and thousands of dollars have been saved, and the owners of the boat in question are satisfied, in this case, to "let well enough alone."

Seven hundred and fifty horse-power placed within the confines of a slim, frail-looking hull but 40 feet long seems like enormous energy and tremendous weight for so small a displacement craft, and yet such a racer so equipped has been in operation and has attained high speed. This would almost seem to contradict the statement already made in regard to "overpowering" a racer. The boat in question was especially designed for such a power and weight of motor, and by a novel construction, the three eight-cylinder engines comprising the power plant were so installed that there was but very little vibration throughout the entire craft. As will be observed from the photograph, a steel truss extended the length of the engine pit, and from this the three motors of the power plant were suspended.

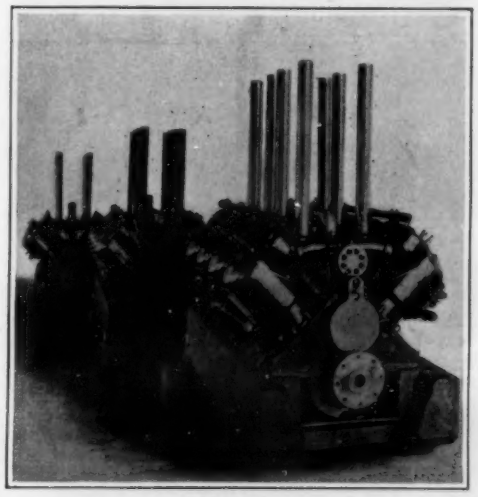
Each eight-cylinder motor was connected with an individual propeller, and when turned at full revolutions, the triple screws could drive the boat at the rate of 42 miles an hour. A seperate clutch was originally installed to connect each motor with its propeller, but there was not sufficient room to make these clutches large enough to carry the full load without slipping, and these finally had to be dispensed with, and were replaced by a solid connection between each engine and its wheel. It is no easy matter to handle three 250-horse-power units connected in such a manner that the boat will move whenever a flywheel turns. The main difficulty encountered was to run the boat slow enough through congested river and harbor traffic. Over an unobstructed course, however, the boat could "have everything her own way."



At the turn remember Newton's first law of motion.



The lines of a racing motor-boat are as graceful as a yacht's.



Power plant of a 40-foot racer; 3 motors, 24 cylinders, 750 horse-power.

An unforeseen difficulty arose when it was desired to use this boat in races over a regulation course having frequent turns. The tremendous power of the three motors, concentrated in the three propellers, exerted such a force in the straight-ahead direction that it was next to impossible to swerve the craft from her course without throttling down to half speed or less. Rudder after rudder was tried, but none would enable the boat to round even the slightest turn at full speed, and on the short straightaways so much time would be lost that the superior speed of this boat could not be taken advantage of. This is a trouble which has probably never been experienced to this extent with any other boat, and it well illustrates how many and unexpected are the problems with which the builders and designers of motor boats have to contend.

Nearly all racers and semi-speed pleasure boats are constructed with the motor located under a front hood, similar to the type known as the "auto boat." The exhaust pipes from each cylinder are led upward through the deck above the motor, and form the "funnels," "smokestacks," or "organ pipes" of the typical racing boat. The force of the unmuffled explosions in the cylinders generally throws the exhaust gases far above the upper end of the pipes, so that they pass harmlessly over the heads of the crew, but instances have been known in which men have been nearly suffocated by these poisonous fumes. In one famous race, indeed, the winner finished the course with two of her crew senseless and with her pilot on the verge of collapse. Peculiar conditions of the wind, or the arrangement of the spray hood, had caused a down-draught that had blown the exhaust gases directly into the faces of the crew, who could find no protection even behind the bulkhead aft of the motor.

Such occurrences are rare, but they are liable to happen at the most unexpected moments. The high-powered racer mentioned above had been run for several weeks with no trouble of this kind from the exhaust gases. On coming into port one day, however, with the motors running slow, the pilot remarked that he had "just got a mouthful of gas"—an occurrence which the designer and owner did not think possible. But it happened that the photographer had taken a picture of the boat at that instant, and when the negative was developed, a puff of the exhaust smoke could be plainly discerned directly in front of the pilot's face. An explosion of less strength than usual, occurring at a time when a peculiar down-draught had blown across the exhaust pipes, was accepted as the explanation of the phenomenon, but the coincidence of this happening at the instant that the photograph was taken was a remarkable one. There is nothing that affects the handling of a motor-boat so much as the size, shape, and location of the rudder and the mechanism by which it is turned. Some boats, at slow speed, may be turned in twice their length, while others will require the "whole river." In a motor-boat race, as in many other speed contests, it is the craft that can get the "pole" that often wins, even though it may be a slower boat on the straightaway than its rivals. But too sudden a turn may be followed by disastrous consequences, for a quick swerve at high speed will cause many boats to tip

(Continued on page 30.)

Much smoke at the start of a motor-boat race.

THE PLEASURE BOAT'S DEBT TO THE RACER

Thirty-horse-power truck and trailer, hauling twenty-one bales of cotton (10,500 pounds).

The Selection of a Motor Truck

(Continued from page 5.)

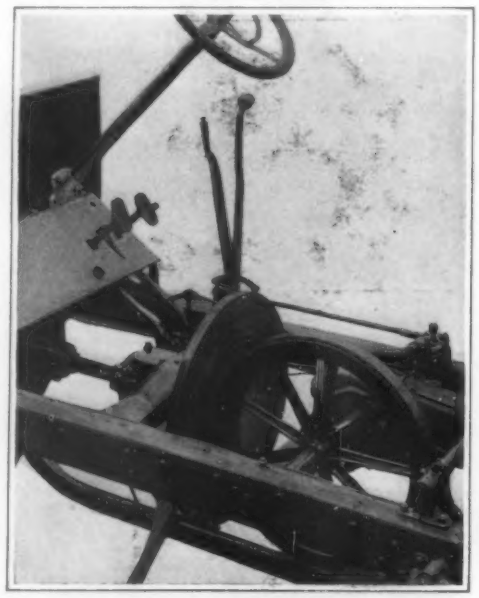
two, or three machines, and as a rule it has not proved satisfactory to give their storage and care into the hands of a public garage. An exception to this general statement exists when the user is located not too far from one of the few garages established in several of the largest cities for the exclusive handling of electric commercial vehicles.

Care and handling of machines, by the way, are of no less importance than their proper selection. It is the common experience of all large users, whether of the electric or gasoline types, that it is both cheaper and more satisfactory to maintain their own garages and hire their own superintendent, mechanics, and drivers than to depend upon outside service. Usually, such stores find the best man they can get, with a special knowledge of storage batteries and a general knowledge of automobile mechanics, to take charge of the garage. Under him or some experienced operator, they teach their horse drivers to run the power wagons. For this they pick their best drivers, who always are eager to get a motor wagon to drive, and look upon it as a promotion and recognition of merit. Sometimes, but not customarily, they receive better pay than previously after becoming expert.

With regard to the mechanics of the electric vehicle, it cannot be gainsaid that it is extremely simple. Design and construction in the various makes on the market are so standardized that the buyer can hardly go wrong in making a choice among any of the leading makes. Motors are commonly supplied by one of the big electric companies and any preferred make of battery will be furnished upon order. The rest, therefore, is a relatively simple matter of designing a running gear properly proportioned to the work to be done. The important point is to select a chassis that combines lightness with strength and good wearing qualities. Friction and noise will be very largely eliminated in a well built machine.

For the manufacturer located on the outskirts of a city, in the country, or in a small community surrounded by ordinary country roads, the gasoline truck is indispensable. Its capacity, however, depends upon the volume of his shipments and the road conditions through all seasons. One or more two-ton trucks may suit his needs better than a five-ton machine. On good, hard roads a five-ton truck can move an enormous amount of freight in a day—as much as fifty tons an average distance of five miles in ten hours, including the time lost in loading and unloading. If quick movement of goods is demanded and deliveries are to be made in various directions, it is advisable to have a plurality of units, permitting trips to be made simultaneously in opposite directions.

It has been established by actual service and by



A variable friction drive.

data obtained in motor truck contests held in various parts of the United States, that as the carrying capacity of the unit increases, the cost per ton miles for haulage decreases. Thus, in the tabulated results of the truck reliability tour in San Francisco last October, the cost of hauling one ton one mile was shown to be 8 cents by trucks of one ton capacity, 5 cents by 1½-ton machines, 3 2/3 cents by 3-ton trucks, 2¾ cents by 4-ton trucks, and 2¼ cents by 5-ton machines. These prices include, besides fuel and lubricating oil consumed, driver's wages at $3 a day on the 1-ton and 1½-ton machines and $4 a day on the larger ones; and depreciation at 12 per cent on a basis of 300 working days per year.

The ton-mile basis of figuring costs can be used only in cases where the truck can be run with full load all the way and where hauls are practically continuous. In retail service expense must be calculated on per package cost over a given route to obtain a basis for comparison with other delivery methods. Mileage and number of stops are the units by which efficiency and economy are measured in retail delivery work. Weight is almost negligible where packages are more bulky than heavy and tax the cubic capacity of the body rather than the load capacity of the chassis.

Storekeepers in small cities and villages, farmers and men engaged in a great variety of other occupations in rural sections find the light gasoline express and delivery wagon best suited to their needs. They are general utility vehicles, capable of negotiating dirt loads at all seasons about as well as horse-drawn wagons and are able to make from two to three times the speed on good roads for short distances and to travel unlimited distances without fatigue. A great advantage of the gasoline delivery wagon and truck is that they cannot be overworked so long as sufficient time is spent each day in keeping them properly adjusted and lubricated, and little replacements made as soon as loss or wear appears. It is simply a matter of keeping them in their best working condition. Express companies, department stores, and some other large users of 3-ton and 5-ton gasoline trucks regularly work them twenty hours a day, believing that by so doing they are earning, or saving, money on their investments faster than if the machine stood idle half the time. The rate of wear on tires and mechanical parts and consumption of oil and fuel are directly proportional to the amount of work done, but the fixed charges go on the same when machines are idle as when they are working; consequently, it pays to keep the power wagons on the move; they do not need rest to recuperate, like a horse. The fixed charges are interest, garage rent or its equivalent; superintendence, insurance, and so on. Depreciation depends upon both wear and time. It used to be figured at 20 or 25 per cent, but experience has shown that well designed and well built trucks, if given proper use

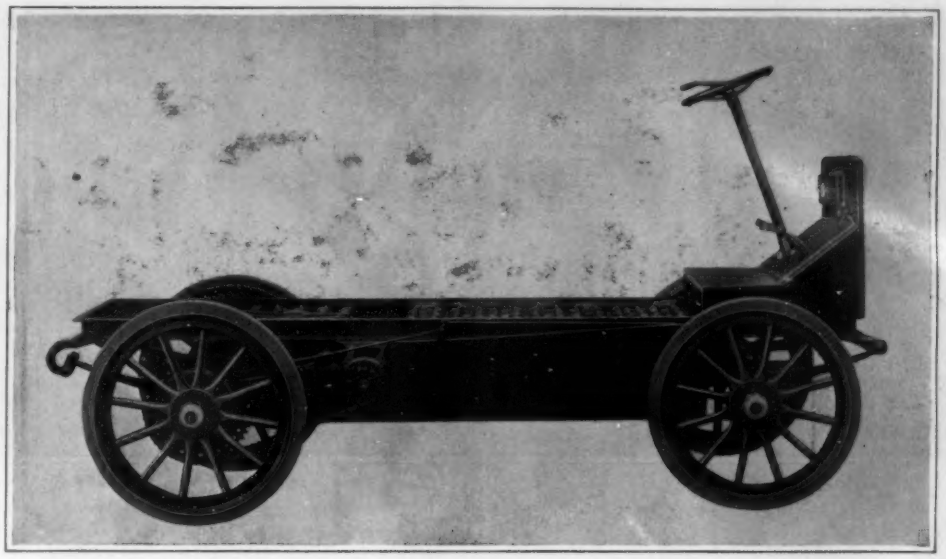
Dumping truck operated by engine power, tail board opening as body tilts.

Three-ton truck loaded with trunks for a large summer hotel.

THE SELECTION OF A MOTOR TRUCK

and care, will continue to give good service for eight to ten years and perhaps longer—the point is still uncertain, because no considerable number of motor trucks were in use as long ago as ten years.

Endless figures showing the cost of operation and maintenance of all kinds and sizes of power vehicles are available, but, unfortunately for the prospective buyer, no attempt has ever been made to collect and tabulate a large number of records of different services covering a period of years, in order to get a table of mean costs that would serve as a standard on which one could rely as a guide to the probable cost of a new installation of any given number of machines of a given kind and capacity under average normal conditions. The task of compiling such a table would be enormous, even if any considerable number of users would consent, in the unselfish interest of progress, to supply data from their records—which is exceedingly doubtful. About all that has been attempted, so far, is to give figures for specific cases, and these usually cover periods of less than a year. Some such figures are given in condensed form on another page of this issue.



Electric truck with battery and driving mechanism below the level of the frame.

As a matter of fact, the actual cost of running a motor vehicle and taking care of it should be of less consequence to any progressive business man than what the machine can do toward building up his business. A motor wagon easily doubles the radius of deliveries and quadruples the territory that can be served. A motor delivery wagon will cover sixty miles or even more, in a day, to twenty by a horse. This superior speed and endurance enables the merchant to make daily deliveries to customers located twenty miles from his store, or to make two or three trips a day over a route twenty miles long. Thus he gains a tremendous advantage over competitors who rely upon horses and wagons.

The selection of a motor truck or delivery wagon from a mechanical standpoint, is rather a difficult subject to discuss in a short paper. There is greater diversity of design in commercial vehicles than ever existed in the pleasure cars. Every type of engine is used, from the single-cylinder to the six-cylinder, and from the two-cycle air-cooled to the four-cycle water-cooled. They are variously placed horizontally under the body, transversely under the seat or hood in front, and vertically in front. There are side-chain drive, shaft drive, gear drive, and even cable drive. In transmissions or change-speed mechanisms there are sliding gear sets, planetary gears, and friction disks. Even in electric vehicles there is much diversity, some makers locating the motors in the wheels, in the rear axle or in yokes at the axle ends. Each system has been proved not only practicable but successful, in some respects making better showings than the standard design.

A compact and accessible engine.

Either necessarily or by desire, the purchaser will in most cases let price determine the particular design selected. That is, he will fix in his mind a price he is willing to pay, and then try to find the machine that, in his opinion, best suits his needs and is the best value for that price. At the lowest prices, from $600 to $1,000, there is not a very wide opportunity for choice, as there are relatively few wagons within these limits, chiefly of the single-cylinder and double opposed types, with one or two three-cylinder air-cooled models. But from $1,000 to $2,000 there is a wide range, embracing all types of gasoline machines up to one ton and one and one-half tons capacity. Those of two to ten tons carrying capacity range from $2,000 up to $5,000 or more.

There are two types of design that are becoming standardized; one, the four-cylinder, motor-in-front machine, which predominates in the heavy truck field and sells at the higher prices; the other, the double-opposed horizontal engine type, with the motor placed crosswise in front, which leads in the medium size and medium price cars. Power for power, the horizontal opposed engine design is the cheaper to build, and it is simple and efficient if properly handled. Many thousands of trucks and wagons of this design are in regular use now, and an increasingly large number are being built each year.

The old, established pleasure car makers, of whom a rapidly growing proportion are producing trucks of 1½ to five tons capacity, almost universally follow the four-cylinder, vertical, motor-in-front design that years of experiment and use have shown to be the best for pleasure vehicles. For flexibility, accessibility, reliability, durability and all-around ability this type of machine appears to be unexcelled, whether for heavy or light work.

Besides these two general types of machines, each class is divided into two other types differentiated by the position of the driver's seat. In some, the seat is placed at the rear of the engine, well back toward the middle of the chassis, as in pleasure cars. In others it is above the engine, with the dash and radiator combined. Advocates of the former argue that their construction brings from 80 to 90 per cent of the weight of the load on the rear wheels, which are the drivers

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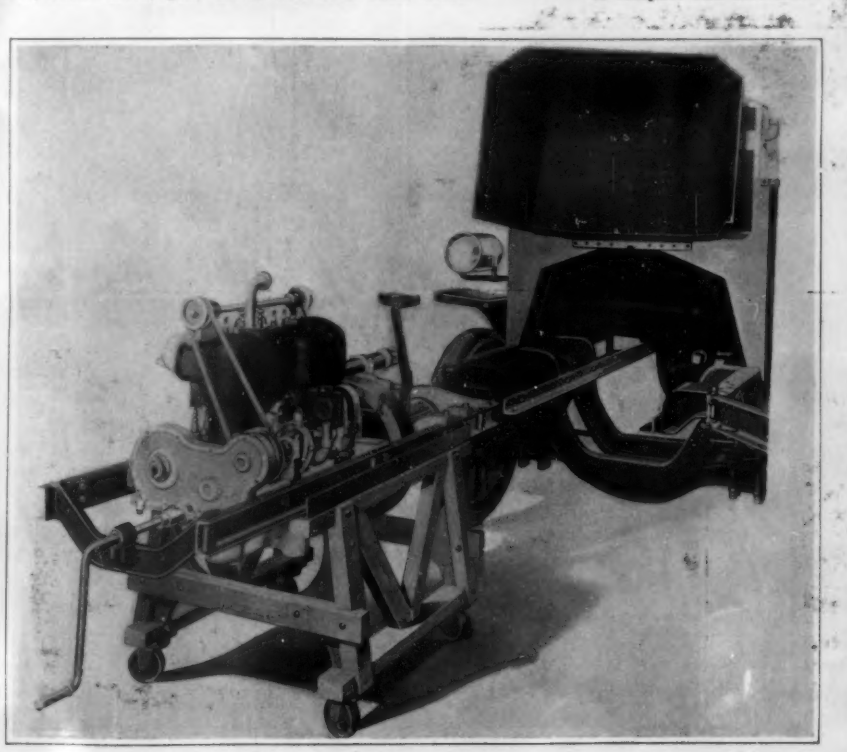
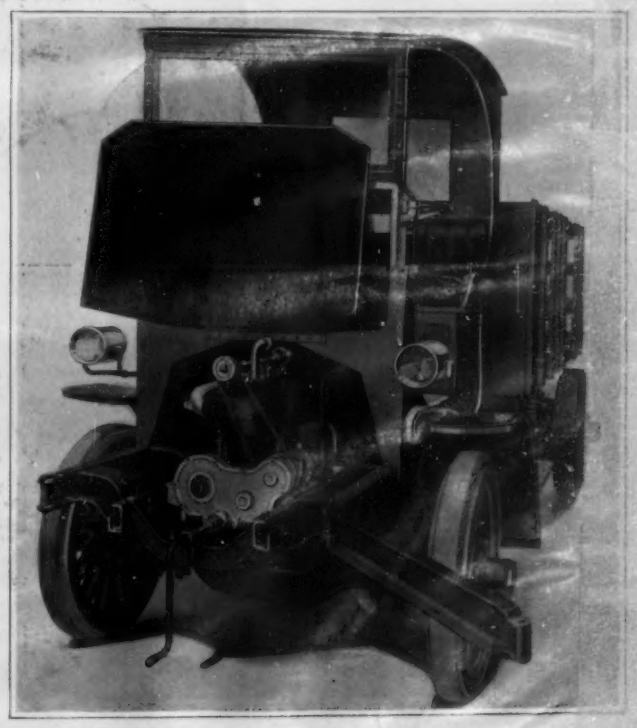


Removing a broken-down engine.



New engine in place; ready to start.

THE SELECTION OF A MOTOR TRUCK

DRIVING THE CAR AT NIGHT

BY H. S. WHITING

To obtain full value from a motor car, it must be available for service at night as well as during the day time. The increasing mileage of "good roads," and the improvement in highway conditions generally, have done much to add to the comfort and safety of night driving and have made speeds after dark possible that, in former years, were considered dangerous to attain, even in the light of day. But, more than anything else, it is the improvement in lights and lighting systems that has rendered driving, and even extended touring, safe at night; and were it not for the powerful headlights which illuminate the roadway for several hundred feet in advance of the car, motoring would be only a daylight pleasure.

Kerosene side-lights serve as effectual signals to other vehicles and to pedestrians, but they are not sufficiently bright for the illumination of the roadway, and consequently they are practically useless for country driving and for traveling through streets not lighted by other means. But it was this failure of the kerosene lamps to meet the need of the situation that brought about the wonderful development in acetylene systems, and to-day we find headlights operated by this gas which are so powerful that sign posts may be read easily several hundred yards in advance of the car. But for such long-range reading, the lamp brackets may need to be bent up in order that the rays may be thrown ahead in a straight line, instead of down on the road in front of the car, as is often the case. A satisfactory method of adjusting the lights is to set one bracket so that the rays from its lamp will be concentrated at a point about fifty or one hundred feet in front of the car, while the other bracket should be tilted so that the light will extend in a more nearly horizontal direction and illuminate the roadway at a greater distance from the car. In this case, the brackets should be turned in slightly so that the middle of the roadway will be illuminated by the center of the rays of light. If desired, the lamps may be turned so that the rays from the two lamps will be concentrated at the same point, or they may be spread apart slightly so that the sides of the roadway will be illuminated, instead of a long pathway directly in front of the car.

Acetylene is the gas formed by the action of water on calcium carbide, and may be generated when desired in a small metal cylinder or box placed on the running board of the car. In order to eliminate the care and trouble required to clean and refill the ordinary generator, however, tanks have been designed which will hold a large quantity of acetylene gas under pressure. These may be stowed in any convenient location, either on the running board, or out of sight under the floor boards of the body, and are connected with the lamps which they operate by means of flexible rubber tubing. Such tanks may be obtained in sizes sufficiently large to operate two headlights for a period of thirty or forty hours, and as there is no waste of the gas when the valve is closed and the lights are not burning, one filling may last for the greater part of a season.

The increase in night driving has created a demand for many attachments to the ordinary lighting systems, and some of these are exceedingly ingenious. Automatic lighters for acetylene lamps, in particular, have received the attention of manufacturers, and the driver of a car so equipped need not worry when "lighting up" time comes for fear of a scant supply of matches. Some of these lighters operate on the same principle as those which lighted the gas jets in our bedrooms and halls a few years ago, with the exception, however, that the newer system is much more compact and can be installed in a short time. Such a system relies for its operation on an electric spark formed directly over the acetylene burner. To obtain this spark two platinum points are attached to the burner. One of these may be mounted on a pivot and brought into contact with the other when a chain, attached to the lower end, is pulled. As these platinum points form the electrodes of an electric current, a spark will be formed when contact is broken, and the gas at the burner will be ignited. In other systems, the two electrodes are stationary and a high-tension current jumps across the gap between them when a button on the dash is pressed. Such lighters may obtain their current from a separate storage cell or set of dry batteries and employ an independent "step-up" transformer, or high-tension coil; while others may use the current from the ignition system. In one lighter of the former type, the high-tension coil is combined with the electrodes in a small brass case, and the entire apparatus is attached to the acetylene burner.

It is necessary first, of course, to turn on the gas before it can be lighted at the burner, and this is done by means of a valve located either on the tank or generator, or on the dash within easy reach of the driver. In one type of lighter, the gas is turned on and the lighting spark formed by the movement of a single lever, which is connected both with the acetylene feed pipe and the electric circuit. A mechanical lighter, different from any of those heretofore described, has been designed which depends for its operation upon the spark formed by the friction between two metals. One of these metals is a sparking alloy which is carried on a pivoted arm that can be swung over a milled surface. The rubbing of the alloy over the rough surface causes a shower of sparks to fly, and when the device is installed on the burner, these sparks will readily ignite the acetylene gas that is escaping into this miniature pyrotechnical display.

The glare from bright headlights is exceedingly confusing to the drivers of other vehicles, and on this account, many municipalities have passed ordinances prohibiting the use of blinding motor car lights on the city streets. This glare may be reduced by pasting paper over the lenses, or by the use of some semi-transparent coating on the glass, but such devices, of course, are

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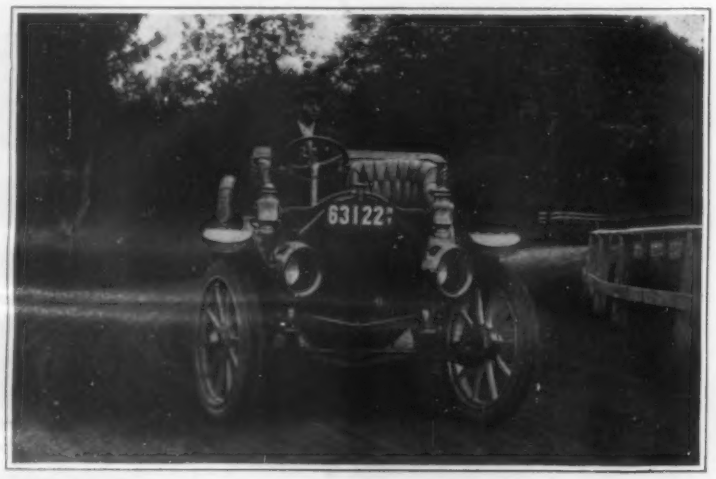


Headlights that turn with the front wheels.

A dangerous curve ahead.

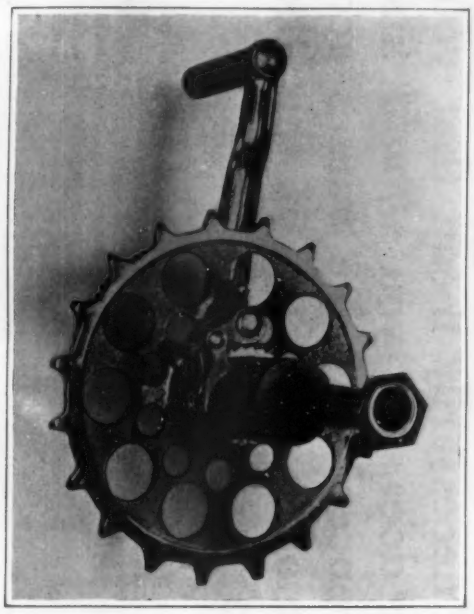
Lamps set for near and distant lighting.

DRIVING THE CAR AT NIGHT

The Motorcycle of 1912

By J. J. O'Connor

THOSE thousands of people who have watched with interest the birth and development of the motorcycle, and have promised themselves the ownership of one of these remarkable machines when they became cheaper, more comfortable, cleaner, quieter and easier to start and to operate, will find their standards attained to a high degree in the 1912 models. During the past year greater advances have been made in motorcycle construction than in any previous twelvemonth in the history of the industry. That long awaited price reduction, which in the very nature of things, was bound to come some day, has arrived with startling suddenness this year. Practically every manufacturer, with one or two important exceptions, has reduced his prices from $15 to $60 as compared with his 1911 models. The average reduction has been $25.



Ratchet gear of the foot starter.

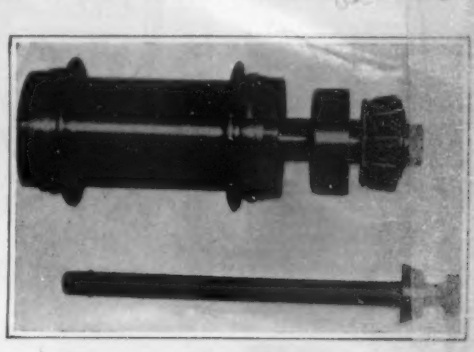
By far the most important improvement in the 1912 machines is that they have been made more comfortable. This has been accomplished chiefly by the introduction of a floating or spring seat. The seat is suspended on a long spring plunger working in the rear diagonal frame tube, there being two springs, one for compression under load, the other for rebound. The arrangement is such that road shocks are almost entirely absorbed before reaching the seat, and consequently the rider is subjected to less shaking on rough roads. Three manufacturers have adopted this device for next year. Another manufacturer seeks to obtain the same result by using a spring frame, the springs being concealed in the rear upper stays, and the rear half of the machine being carried on springs instead of the rider alone. Still another method adopted to secure easier riding is the fitting of larger tires. The standard motorcycle tire is 28 by 2½ inches, but some of the new models carry 2¾-inch tires as standard equipment, and nearly all are equipped with rims which will take this size.

No longer is it necessary to go through heart-breaking and undignified contortions to start a motorcycle. Just as the self-starter has come with a rush on motor cars, the foot starter has arrived on the motorcycle. So far but one maker offers it, but it is certain to find a great many advocates when its true worth is realized by riders. As now offered, the foot starter is a pedal crank connected to the motor shaft by chain through a ratchet mechanism, and one stroke of the foot pedal "spins" the motor two revolutions. The starter can be operated with slight physical effort, is simple and practically fool proof, and there is no danger of injury through "backfiring," this possibility being provided for. With the foot starter the motorcycle may be started by a push of the foot with the operator in the saddle and both wheels on the ground, no wheel "jacking" and pedaling being necessary. In Great Britain the foot starter is fitted to several of the leading machines for next year. Those manufacturers who have not offered the foot starter yet in this country, nevertheless have made their machines easier to start through improvements in the carbureter and magneto.

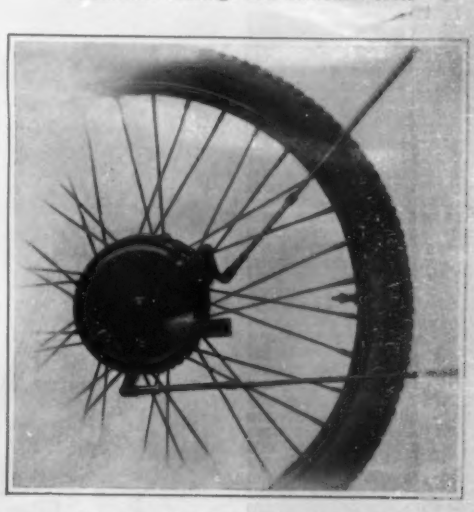
Perhaps no greater objection has been raised against the motorcycle than that of its being noisy. While much of this prejudice is unwarranted because the machines are quiet when shipped from the factory and are tampered with by owners who want more speed, the 1912 models are quieter than ever before. Mufflers are larger and more efficient, exhaust pipes also are larger and longer, and the fitting of "tail pipes" for the final expansion of the burnt charge before it escapes into the open air have contributed greatly to silence. Muffler cut-outs still are rather general, although there is positively no need for them with the present high-powered motors. It is the abuse of the cut-out by opening it in cities and towns, either as a warning signal, or "just because the rider likes the noise" that has done so much to bring the motorcycle into disrepute with the public. Manufacturers continue to fit the cut-out, because they claim, that if they do not many riders will remove the insides of mufflers or bore holes in them, and thus cause machines to be continually noisy.

Contrary to the very general notion, it is not necessary to wear overalls and jumper on a motorcycle, and it is not impossible to wear good clothes and preserve a neat appearance. For next year, riders will be better protected from mud and oil than ever before. Motors have been made more oil tight, and larger and better mud guards have been fitted. A large number of motorcycles affect an unprepossessing attire, due either to indifference to public opinion, or to thoughtlessness, but the man who wants to look neat on a motorcycle can do so without fear of ruining his clothes. A light duster, puttees, cap, gloves and goggles are all that is necessary, and make a very neat outfit.

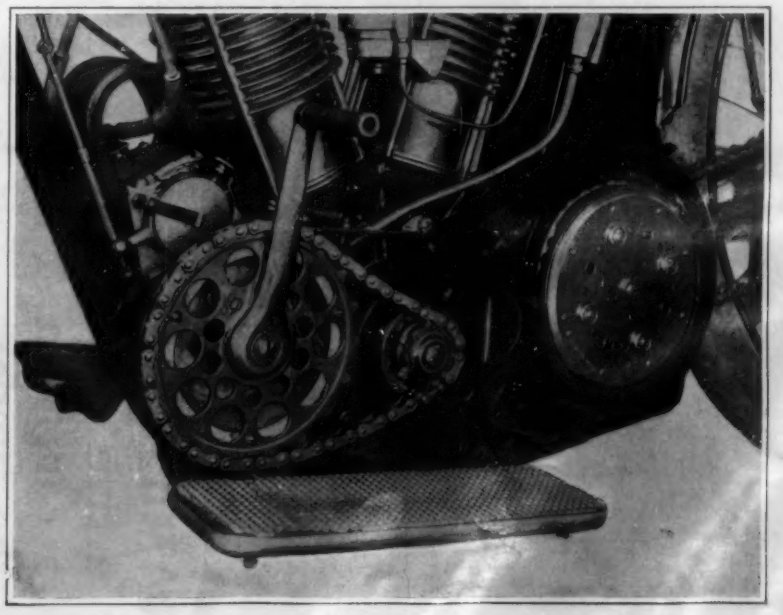
In their pursuit of perfection motorcycle designers have not hesitated to borrow from their bigger brothers, the motor car makers. During the past year such features common to motor cars as the multiple jet carbureter, dry plate multiple disk clutch, double brakes and roller bearings have been applied to motorcycles. The multiple jet carbureter, as its name indicates, has two spray nozzles instead of one, as in the ordinary device. In the double jet carbureter the regular nozzle is supplemented by a small one which has smaller gasoline and air passages, and gives a much reduced charge for slow running in traffic. For all ordinary running the motor is fed by the small jet, which always is open to the motor, and when more power is required, the throttle is opened, bringing the main jet into action, and both jets then work automatically in unison. When the throttle is closed the main jet is cut off from the motor entirely, but the small jet never is throttled. In addition to greater flexibility, increased economy and silence are obtained with the use of the multiple jet carbureter. Two manufacturers now are using it.



Automobile bearings and knockout axle.



Wheel equipped with double brakes.



Foot starter coupled to motor shaft.

The starting crank returns automatically when released. Footboards are used in place of pedals.

THE MOTORCYCLE OF 1912

both having taken it up this year. While the disk clutch really came out on the 1910 and 1911 machines, its use was confined to one or two makes, but for next year several other manufacturers have adopted it, and it has lost none of its early advocates. While it is made in several forms the underlying principle of steel disks running metal to metal, or with anti-friction lining interposed between the plates, is the same. Some makers place it on the motor shaft, others on a countershaft between the motor and rear wheel, and still others on the rear hub.

Two manufacturers now are using the double brake system, one of whom led the way in this respect last year. Many riders believe in double brakes, particularly with the big motors now in use, but so far most makers have seen fit to send their machines out with one brake. In Great Britain two brakes are required by law, but in this country there is no such compulsion. While the bicycle coaster brake in enlarged form is here generally used, the automobile type of band brake of the contracting type also is very popular, and in the double system is supplemented by an internal brake. Brake control is by foot pedal except in one instance where the double system is used, a hand control being fitted for the band brake.

Magneto ignition is almost universal, although a few makers offer battery and coil on their cheapest model. Improvements in magnetos also have rendered them better protected against short circuiting by mud and water than heretofore. One of the bicycle makers who has entered the motorcycle field uses a shaft and bevel gear drive for his magneto, as also does a motor manufacturer, but all others depend on enclosed spur gear drive. Automobile type roller

(Continued on page 29.)

Overland

The Mechanical Excellence of this $900 30-Horsepower Touring Car

FAMILIARIZE yourself with the mechanical side of an automobile and you can quickly arrive at any car's real value. This does not necessarily mean that you should know a car from A to Z as a professional engineer does, but you *should* know enough of the fundamentals to be able to tell the difference and judge values accordingly. The chassis is the backbone of an automobile and the more you know of this the more intelligently you can estimate a car's value in dollars and cents.

We have asked you to measure up the facts of this $900 car against the facts of any $1250 car on the market in order to show you the slight difference. Here we wish to acquaint you with the mechanical side of this car—to prove the thoroughness and fineness of its entire construction. And the mechanical excellence of this $900 thirty horsepower touring car is best explained by a brief synopsis of the facts covering its construction.

The motor is a four-cylinder, four-cycle type of Overland design and manufacture. Cylinders are cast singly and have large water jackets. Crank shafts, connecting rods and other motor forgings are made of high carbon *manganese* steel. The motor is suspended from three points on the main frame, and is [illegible] from 35% nickel steel heads, electrically welded to carbon steel skirts. Their design and large size enable the motor to *develop*

column gear is placed in such a manner as to minimize stresses and vibrations.

The transmission is of the selective type—three speeds and reverse. The speed changing, final drive, and differential gears are contained in the rear axle unit.

A smoother, more delicate, and at the same time more positive clutch than the Overland cone clutch does not exist. It is of such design and construction that in starting the car there is never a shock or jar. The facing is not lubricated. It is, therefore, unaffected by weather conditions.

This is the only car in its class provided with a five-bearing crank shaft. This crank shaft is dropped forged from one piece of [illegible] in five bearings of unusually

Lubrication is provided by a force feed mechanical oiler actuated by the cam shaft.

Springs are of the semi-elliptic and three-quarter elliptic type. The rear springs are mounted on spring chairs that have a lubricated bearing on the rear axle tubes. This form of construction produces an easy-riding car, as it permits the springs to act freely.

Final drive is effected from the propeller shaft to the rear axle by means of accurately cut and carefully hardened bevel gears, the usual differential and two live axle shafts which drive the rear wheels. Special roller bearings are provided for all rotating components, and the bevel gears and pinion are of drop-forged nickel steel, cut in accurate Overland style, and scientifically heat treated.

We have tried to make this as brief as possible without omitting any of the essentials. It is the kind of information that shows

We have published a book which we want you to read. It covers in detail every single part of this car. Not only what the

motor forgings are made of high carbon *manganese* steel. The ... is suspended from three points on the main frame, and is ... from 35% nickel steel heads, electrically welded to carbon steel stems. Their design and large size enable the motor to *develop 15% more horsepower* than any other motor of the same bore and stroke.

The radiator is of the famous Kinwood flat tube type. The radiating surface is unusually large, with large diameter intake and outlet openings.

The frame is constructed of cold rolled pressed steel, formed in channel sections of effective design, great strength and stability.

Steering gears are of worm and worm-gear type. The steering connecting rod between the steering knuckles and steering

This is the only car in its class provided with a five-bearing crank shaft. This crank shaft is dropped forged from one piece of ... and is carried in five bearings of unusually ...

Lubrication is provided by a force feed mechanical oiler actuated by the cam shaft.

Wheels are of heavy artillery type of special construction and equal to those used on the most expensive cars.

Front axles are of the I-beam section type, drop-forged in one piece, heat-treated in the most approved manner in our own factories, and capable of withstanding the severest road shock.

Brakes are particularly large and have ample friction areas. There are two brakes on each rear wheel, the inside or foot-brake which is internal expanding; the outside or emergency brake which is external contracting.

heat treated.

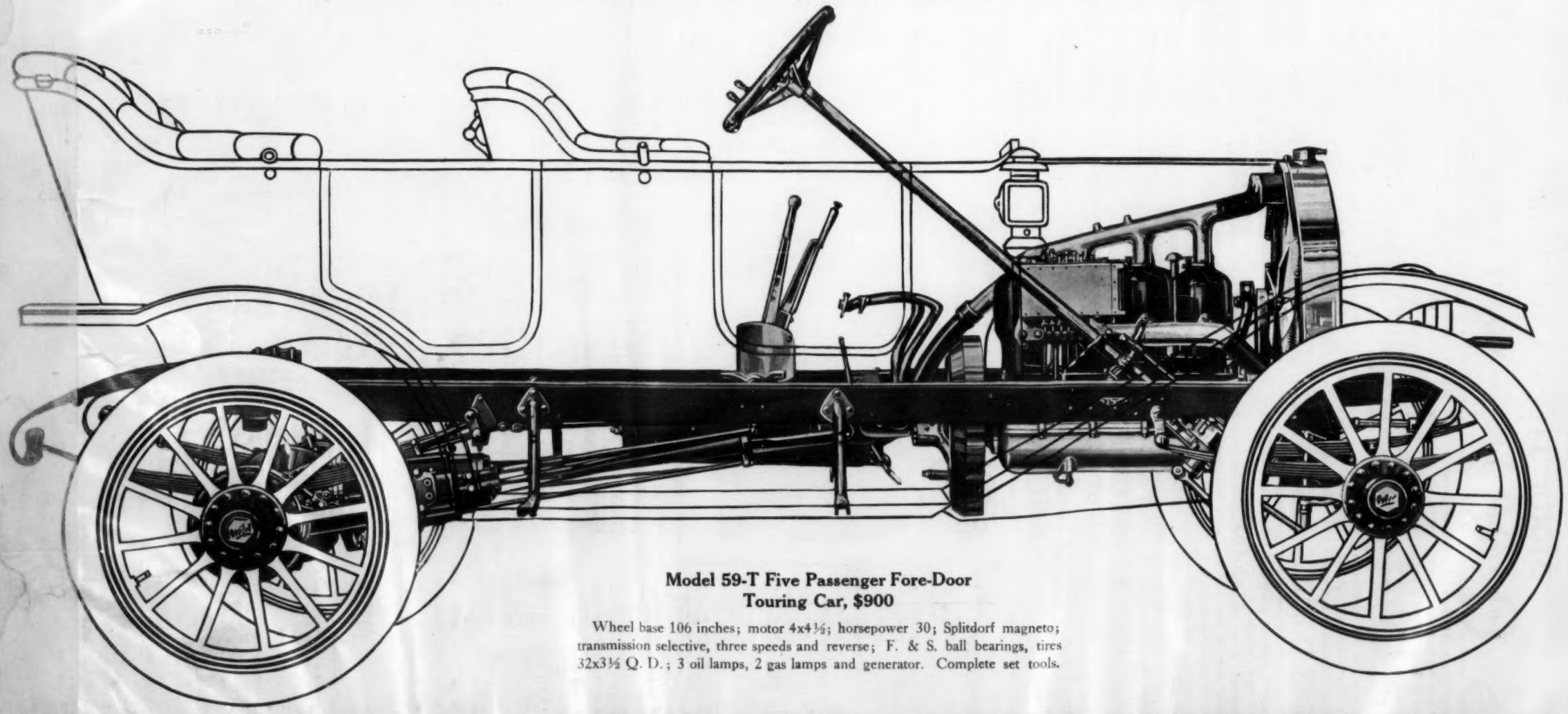
We have tried to make this as brief as possible without omitting any of the essentials. It is the kind of information that shows ...

We have published a book which we want you to read. It covers in detail every single part of this car. Not only what the construction is, but how each part is made—showing each factory operation from body to bolt.

Better let us send you one of these books. It is the most interesting and thorough work of its kind ever written and fully explains the ability of the greatest automobile plant in the world to make a car of the 30-horsepower, 5-passenger touring car type to sell at from 30% to 40% less money than any other similar car on the market.

Write to-day and ask for book F21.

The Willys-Overland Company, Toledo, Ohio



Model 59-T Five Passenger Fore-Door Touring Car, $900

Wheel base 106 inches; motor 4x4½; horsepower 30; Splitdorf magneto; transmission selective, three speeds and reverse; F. & S. ball bearings, tires 32x3½ Q. D.; 3 oil lamps, 2 gas lamps and generator. Complete set tools.

Motor Truck Cost Charts

Tables Prepared by Leading Motor Truck Manufacturers

OF the making of cost charts there is no end. So many different matters need to be considered that each specific case under consideration brings a different total. For this reason the majority of manufacturers prepare tables of a general character which do not aim to give specific detailed information, but only average results. Although motor truck manufacturers can secure complete and exact figures, the information is nearly always of a confidential character and must not be disclosed to other companies engaged in the same line. Even could the data be given out, in all probability it would not apply to the case of the prospective purchaser in the same business. It is impossible for a man to make his own diagnosis, look up a table of costs and decide for himself that "specific No. 77" would fit his case. For instance, Messrs. Brown & Smith run a large department store of the highest class, with a high percentage of charge accounts. If their motor delivery figures be given to the department store of Messrs. Jones & Green, which carries a cheaper line of goods, the latter firm will be surprised to find that its transportation charges would work out in actual practice considerably higher than those of the former department store. In one case the deliveryman takes the packages to the basement door, leaving his delivery wagon standing for but a moment. In the other case, he must ring the bell for the maid, wait while she hunts for her mistress, and wait for the latter to hunt for her pocketbook. After considerable delay, he completes his delivery and returns to his wagon which has been standing idle for many precious minutes at the curb. If the vehicle be driven by a gasoline engine, the chances are that the motor will be left running while the delivery is being made; hence there will be a loss of fuel during that period of time. But at any rate, whether the vehicle is driven by gasoline or electric motor, the interest charges on the investment and the driver's wages must all be figured into the delay. This is but one instance of many hundreds which the tabulator of motor truck costs could cite, to emphasize the point that every case needs its own individual treatment and investigation at the hands of an expert.

Another fact that is of the greatest importance in the consideration of motor truck cost as compared with the cost of horse-drawn vehicles, is that very few companies know exactly what their horse transportation costs them. Often they do not even know what the exact investment in horses, trucks, stables and other equipment represents. Maintenance charges and labor charges are not figured down to the last cent, and there is no adequate charge for depreciation on the equipment to pay for renewals. Such being the case, it is hardly fair for the intending purchaser to make his own comparison of the horse truck with the motor truck.

While general cost tables may not be of any direct value, in specific cases they are undoubtedly of interest and do give one an approximate idea of the relative saving that may be effected in most cases, by the machine over the horse. We publish herewith a number of tables prepared by leading manufacturers of both electric and gasoline motor trucks.

The tabulation covering the general average operating cost of gasoline trucks in the first table is intended to supply those figures which can be regarded as the average annual costs of the critical items of operation. It is impossible to supply figures in those cases which are marked "variable," but any investigator desiring to determine the cost of operating a truck in his particular service, by selecting the "maximum maintenance" or "ordinary maintenance" figures which suit his particular condition of operation and adding thereto the other charges in the table as well as supplying figures for those marked "variable," can arrive at a fair estimate of operating costs suiting the conditions.

TABLE I.

GENERAL AVERAGE OPERATING COSTS OF GASOLINE TRUCKS.
(Annual)

MACHINE SIZE	2 Tons	3½ Tons	5 Tons	6½ Tons
FIXED CHARGES:				
Interest on investment at 6 per cent.	$306	$372	$476	$547
Depreciation non-wearing parts at 10 per cent.				
MAINTENANCE: — Maximum Service (Loaded outgoing and returning)				
Wearing Parts	$542	$660	$849	$981
Tires	478	692	1,010	1,182
MAINTENANCE:—Ordinary Service (Loaded outgoing and returning empty)				
Wearing Parts	$325	$396	$509	$589
Tires	358	519	757	886
GARAGING:				
Storage Washing—Variable				
Garage Labor—Variable				
Insurance Variable				
OPERATION:				
Gasoline	$250	$292	$333	$375
Lubricating Oil	39	78	105	118
Operator—Variable				
Helper—Variable				
Licenses—Variable				
Total				

Above figures are based on a service of 50 miles per day.

NOTE.—To compute annual cost of operation, select figures including "maximum" or "ordinary" maintenance, as may suit the service and supply those "variable" charges peculiar to the conditions of operation.

Another manufacturer supplies the following tables:

TABLE II.

COST TABLE OF OPERATING GASOLINE TRUCKS.

2½-ton model

Based on the following average miles run per day.

Cost per mile.	40	50	60	70	80	90	100
Driver	.0835	.0667	.0556	.0477	.0417	.0371	.0334
Gasoline	.015	.015	.015	.015	.015	.015	.015
Lubric'n	.002	.002	.002	.002	.002	.002	.002
Insurance	.0125	.01	.00832	.00714	.00625	.00556	.005
Deprec'n	.025	.025	.025	.025	.025	.025	.025
Tires	.055	.055	.055	.055	.055	.055	.055
Maint'ce	.04	.04	.04	.04	.04	.04	.04
Interest	.021	.0168	.014	.0127	.0105	.00932	.0084
Total cost per mile.	.2540	.2305	.21492	.20454	.19545	.18898	.1838
Cost per ton mile.	.1016	.0922	.08595	.081816	.07818	.075599	.07352
Cost per day.	$10.16	$11.52	$12.89	$14.31	$15.63	$17.00	$18.38

Tables II and III are based on the following:

Driver's wages per week	$20.00
Gasoline per gallon	.12
Lubricating oil per gallon	.75
Insurance per day	.50
Depreciation per mile	.025
Tires, based on manufacturers' guarantee of ten thousand miles, per mile	.055
Maintenance, including yearly overhaul, per mile	.04
Interest on investment at 6 per cent per year on $4,200, cost of truck less tires.	

TABLE III.

3½-ton model.

Based on the following average miles run per day.

Cost per mile.	40	50	60	70	80	90	100
Driver	.0835	.0667	.0556	.0477	.0417	.0371	.0334
Gasoline	.0172	.0172	.0172	.0172	.0172	.0172	.0172
Lubricat'n	.002	.002	.002	.002	.002	.002	.002
Insurance	.0125	.01	.00832	.00714	.00625	.00556	.005
Deprec't'n	.025	.025	.025	.025	.025	.025	.025
Tires	.065	.065	.065	.065	.065	.065	.065
Maint'ce	.04	.04	.04	.04	.04	.04	.04
Interest	.023	.0184	.01533	.01313	.0115	.01022	.0092
Total cost per mile.	.2682	.2443	.22845	.21717	.20865	.20208	.1968
Cost per ton mile.	.0766	.06979	.06527	.06205	.059601	.05771	.05623
Cost per day.	$10.72	$12.21	$13.71	$15.20	$16.69	$18.18	$19.68

TABLE IV.

4½-ton model.

Based on the following average miles run per day.

Cost per mile.	40	50	60	70	80	90	100
Driver	.0835	.0667	.0556	.0477	.0417	.0371	.0334
Gasoline	.0200	.0200	.0200	.0206	.0200	.0200	.0200
Lubric't'n	.002	.002	.002	.002	.002	.002	.002
Insurance	.0125	.01	.00832	.00714	.00625	.00556	.005
Deprec't'n	.03	.03	.03	.03	.03	.03	.03
Tires	.07	.07	.07	.07	.07	.07	.07
Maint'ce	.04	.04	.04	.04	.04	.04	.04
Interest	.0253	.0202	.01683	.01443	.01263	.01123	.0101
Total cost per mile.	.2833	.2589	.24275	.23127	.22258	.21589	.2105
Cost per ton mile.	.06297	.5753	.05393	.05139	.04946	.04797	.04677
Cost per day.	$11.33	$12.94	$14.56	$16.18	$17.80	$19.43	$21.05

This table is based on the following:

Driver's wages per week	$20.00
Gasoline per gallon	.12
Lubricating oil per gallon	.75
Insurance per day	.50
Depreciation per mile	.03
Tires, based on manufacturers' guarantee of ten thousand miles, per mile	.07
Maintenance, including yearly overhaul, per mile	.04
Interest on investment at 6 per cent per year on $5,050, cost of truck less tires.	

TABLE V.

6½-ton model.

Based on the following average miles run per day.

Cost per mile.	40	50	60	70	80	90	100
Driver	.0835	.0667	.0556	.0477	.0417	.0371	.0334
Gasoline	.024	.024	.024	.024	.024	.024	.024
Lubric't'n	.002	.002	.002	.002	.002	.002	.002
Insurance	.0125	.0100	.00832	.00714	.00625	.00556	.005
Deprec't'n	.03	.03	.03	.03	.03	.03	.03
Tires	.09	.09	.09	.09	.09	.09	.09
Maint'ce	.04	.04	.04	.04	.04	.04	.04
Interest	.02675	.0214	.01784	.01528	.01337	.0119	.0107
Total cost per mile.	.30875	.2841	.26776	.25612	.24732	.24056	.2351
Cost per ton mile.	.0475	.043707	.0419	.0394	.03804	.03693	.03613
Cost per day.	$12.35	$14.20	$16.06	$17.92	$19.78	$21.65	$23.51

Table V. is based on the following:

Driver's wages per week	$20.00
Gasoline per gallon	.12
Lubricating oil per gallon	.75
Insurance per day	.50
Depreciation per mile	.03
Tires, based on manufacturers' guarantee of ten thousand miles, per mile	.09
Maintenance, including yearly overhaul, per mile	.04
Interest on investment at 6 per cent per year on $5,350, cost of truck less tires.	

The following is a table of comparative cost of horse-drawn trucks and electric trucks at a prominent New England mill.

TABLE VII.

TEAMING.

Total cost for 5 years ending Dec. 29th, 1907 (not including hired teams for mill coal)	$33,419.49
Of which the labor of drivers and helpers	24,961.77
Leaving as cost of grain, shoeing, harness repairs, horse renewals	$8,457.72
As this is for 10 horses for 5 years, the cost per horse per year	169.17

ELECTRIC TRUCK.

Cost complete, including battery, etc.	$3,400.00
Estimated cost of charging equipment, to charge 3 trucks	250.00
Spare parts, in case of accident	350.00
Amount invested in electric truck, etc.	$4,000.00
For comparison with horses, deduct estimated value of 4 horses, carts	1,000.00
Excess amount invested, say	$3,000.00

EXPENSE OF 2-TON TRUCK PER YEAR.

Interest on investment, 6 per cent	$180.00
Depreciation, 10 per cent (Batteries and Time below)	310.00
Batteries, $207; Tires, $235 (each said to run one year)	442.00
Two men to operate truck, one at $1.75; one at $1.25	900.00
Cost to operate truck one year	$1,832.00
On the basis of last five years' cost of teaming, the displacing of 4 horses, 4 men on two double teams, would be 4 horses at $169.17 per horse	676.68
Four men at same rates as above	1,800.00
	$2,476.68
	1,832.00
Saving by the use of one truck	$644.68

A leading electric truck manufacturing company gives the following *guaranteed* costs and mileages: Mileages 20 per cent under maximum.

TABLE VI.

COST OF OPERATION—2-TON ELECTRIC TRUCK.

Mileage per annum—9390 (300 days per year).

Item.	Per Annum.		Per Day.		Per Mile.		Per Ton Mile		Per Cent of Total.	
FIXED CHARGES:										
Amortization	$340.00		$1.1333		$0.0362		$0.0181		12.82	
Interest	102.00		0.3400		0.0109		0.0054		3.84	
Fire Insurance	34.00		0.1133		0.0036		0.0018		1.28	
Liability Insurance	100.00		0.3333		0.0106		0.0053		3.76	
Total—Fixed Charges		$576.00		$1.920		$0.06¹³		$0.0306		21.70
REPLACEMENT CHARGES:										
Renewal of batteries	289.00		0.9633		0.0308		0.0154		10.88	
Renewal of tires	286.60		0.9553		0.0305		0.0152		10.80	
Renewal of chains	37.90		0.1263		0.0040		0.0020		1.43	
Renewal of gears and sprockets	59.05		0.1964		0.0063		0.0032		2.22	
Renewal of bearings	30.35		0.1011		0.0032		0.0016		1.14	
Renewal of all other parts	40.00		0.1333		0.0043		0.0022		1.51	
Total—Replacement Charges		742.90		2.476		0.0791		0.0396		27.98
GARAGE CHARGES:										
Electric power	218.80		0.7293		0.0232		0.0116		8.23	
Rent, light, and heat	136.15		0.4537		0.0145		0.0073		5.13	
Garage labor	232.00		0.7733		0.0247		0.0123		8.74	
Total—Garage Charges		586.95		1.956		0.0624		0.0312		22.10
DRIVER		750.00		2.500		0.0798		0.0399		28.22
Grand Total		$2655.85		$8.852		$0.2826		$0.1413		100.00

SUMMARY.

Per week (50 per year)	$53.117	Per mile (31.3 per day)	$0.2826
Per day (6 per week)	8.852	Per ton-mile (62.6 per day)	0.1413

No-Rim-Cut Tires—10% Oversize

1911 Sales—409,000 Tires

Stop for a moment, Mr. Tire Buyer, on this verge of 1912.
Consider how motorists are coming to Goodyear No-Rim-Cut tires.
Six times the demand of two years ago—800,000 sold.
Enough sold last year to completely equip 102,000 cars.
Now the most popular tire in existence.

Just because one user says to another—"These tires avoid rim-cutting, save overloading. They've cut *my* tire bills in two."

For the coming year, 108 leading motor car makers have contracted for Goodyear tires. We've increased our capacity to 3,800 tires daily.

Now make a resolve—to save worry and dollars, to give perfection its due—that you'll make a test of these patented tires.

Upkeep Reduced $20 Per Tire

These are the facts to consider:

No-Rim-Cut tires now cost no more than other standard tires. The savings they make are entirely clear.

And those savings are these:

Rim-cutting is entirely avoided.

With old-type tires—ordinary clincher tires—statistics show that 23% of all ruined tires are rim-cut.

All that is saved—both the worry and expense—by adopting No-Rim-Cut tires.

Then comes the oversize.

No-Rim-Cut tires, being hookless tires, can be made 10% over the rated size without any misfit to the rim.

So we give this extra size.

That means 10% more air—10% added carrying capacity. It means an overtired car to take care of your extras—to save the blow-outs due to overloading.

And that with the average car adds 25% to the tire mileage.

All that without extra cost.

Tire expense is hard to deal with in any general figures.

It depends too much on the driver—on proper inflation—on roads, care, speed, etc.

But it is safe to say that, under average conditions, these two features together—No-Rim-Cut and oversize—cut tire bills in two at least.

We figure the average saving—after years of experience with tens of thousands of users—at $20 per tire.

Whether more or less, it means something worth saving. It totals millions of dollars every year to users of these tires.

And you get your share—without added cost—when you specify Goodyear No-Rim-Cut tires.

The New Goodyear Non-Skid Tread

Non-Skid Treads, if Wanted Double-Thick, Deep-Cut Blocks

The newest addition to No-Rim-Cut tires is this ideal Non-Skid tread. Not a mere makeshift—not a flimsy protection. Not a mere corrugation of the regular tread.

This is an extra tread, about as thick as the regular, vulcanized onto the regular tread. Thus a double-thick tread, made of very tough rubber, reducing danger of puncture by 30%.

The blocks are deep-cut and enduring. They present to the road surface countless edges and angles, so skidding is avoided.

Each block widens out at the base, so the strain is spread over as much tire surface as with smooth-tread tires.

Note the many ways in which this Non-Skid tread surpasses all the others.

GOODYEAR

No-Rim-Cut Tires
With or Without Non-Skid Treads

13 Years Spent Testing Tires

Thirteen years ago we started out to outdo others on automobile tires.

We brought to our factory the best experts we knew, and put them at work in our laboratory.

We gave them carte blanche on expense.

For rubber we supplied them with up-river Para, the costliest and best in existence. For fabrics we gave them the long-fibre Sea Island cotton, at twice the cost of the usual.

To prove out their ideas we built a tire testing machine. There four tires at a time are constantly worn out under all sorts of road conditions, while meters record the mileage.

There we have compared 40 formulas for wear-resisting treads. There we have compared over 200 fabrics.

There every method of making, of wrapping, of vulcanizing has been put to infallible test.

And there every competing tire of merit has been compared with our own, under actual road conditions.

We've done this for 13 years.

Whatever proved best was adopted. Then displaced when we found something better.

Thus Goodyear tires have been brought so close to perfection that last year our liberal warrant cost us less than 32 cents per tire.

So it is more than our patents—more than our oversize—which has brought Goodyear tires to such immense popularity. It has been the knowledge that, despite all claims, in the test of time worth alone will prevail.

And our figures reveal the result.

Our new Tire Book is ready—filled with facts which motorists should know. Ask us to mail it to you.

THE GOODYEAR TIRE & RUBBER COMPANY, First Street, AKRON, OHIO

Branches and Agencies in 103 Principal Cities

We make All Kinds of Rubber Tires, Tire Accessories and Repair Outfits

Main Canadian Office, Toronto, Ont. **Canadian Factory, Bowmanville, Ont.**

(435)

Making Chauffeurs of Teamsters

By Harry S. Houpt

In view of the rapidity with which motor trucks are being adopted in all parts of the country it is interesting to consider whether it is more advisable to press a chauffeur into service as a motor truck driver or to use an ordinary teamster for the work.

The policy of a certain large motor truck company is to recommend the latter course, believing that the teamster better understands the matters of hauling and delivering goods, and is, therefore, closer to the details of handling traffic.

Of course, the teamster needs to be taught the operation of the motor truck. And for that reason the following method has been adopted.

When a company decides to abandon horses and install motor trucks it is recommended that the teamsters be sent at to the motor truck factory. Here the first lessons are taught. For one week the drivers are placed in the care of an expert, and with him they go over the truck in the making. Various working parts of the truck are shown and an explanation is given as to the effect of neglect upon these parts. The proper care to be given is explained, and the physical operation of the truck also is gone into in detail.

The following week the drivers put the theories into actual practice. Instead of being put absolutely upon their own responsibility in the running of the truck, however, they are accompanied on trips by an instructor. The driver now gets his most valuable experience. For from three to five days, as the occasion may demand, he operates the truck, with the expert at his side to instruct him further on the fine points of driving. Handling the truck in crowded traffic until he gains the confidence required, the driver is now ready to take full charge of the vehicle. Apart from operating the truck, the new driver is also taught the duties in the way of caring for his machine. The proper lubrication is emphasized; likewise, the things to do every morning before the truck is started on its day's work, and the mastering of simple adjustments now are known.

The good effect of a course of instruction such as this is easy to understand. The inexperienced teamster has in a brief time been made a finished motor truck driver. He has been made to feel the importance of the proper care of the vehicle. He is made not merely a motor truck enthusiast, but an expert. It is a fact that nine-tenths of the trouble experienced with motor trucks is due to ignorance on the part of the driver. This lack of knowledge makes itself known in neglect. The neglect is not wilful, and generally would not exist if the truck operator had been informed by practical methods how to run the truck, and the proper attention that it demands.

But the instruction does not end here. After the driver is pronounced capable of handling the truck, a representative of the maintenance or service department keeps in close touch with him, and makes it a point to care for the vehicle after it is sold. This representative calls upon the driver at stated intervals and inspects the working parts of the truck. If the inspector finds that certain parts of the machinery are not properly oiled and cared for according to previous instructions, he points out the fact to the driver. In addition to these instructions, verbally given, books are furnished. These contain specific and minute instructions as to what the driver is expected to do from time to time to keep the truck in proper working order.

The advantages of making a motor truck driver out of a teamster are evident. The teamster is by nature better equipped to do his work. An automobile driver may know more about the mechanism of a truck, but he is unfamiliar with the type of work demanded of a motor truck driver. He is, therefore, unfitted for the duties of teaming.

In this course of instruction the inexperienced man is developed much after the method employed in instructing motor men on street cars. The ability he possesses as a truck teamster is brought out to its fullest possibilities, and the result is to make him much more enthusiastic and energetic about his work.

It is as logical for the teamster to become a motor truck operator as for the cab driver to be developed into a chauffeur. The problems of each are parallel. The teamster understands transportation of goods, and would be as unfitted to operate an automobile with ease as the cab driver is to drive a motor truck.

Light and Heavy Car Costs Compared

By Harry W. Perry

PROBABLY the majority of motorists who have enjoyed automobiling during several successive years have started with the small runabout and passed through the light touring car class to the heavy touring car. The small car naturally stimulates the desire for the more powerful and more comfortable machine, with its superior speed, hill-climbing ability and endurance under heavy loads and over difficult roads. Except among the wealthy the transition from the small car to the larger one, and from the light car to the heavy one is accompanied by a serious consideration of the probable greater cost, both of the machine itself and of the numerous items connected with its operation and maintenance. In a general way, it is known that it costs considerably more to keep and run a large car than a small one, but really definite knowledge or information of a comparative nature is rare and difficult to obtain.

The writer is happily able to give precise figures of the actual cost of motoring for a year each with two types of car, one a light touring car and the other a heavy machine of equal passenger seating capacity. The comparison of costs has the greater value because both cars were used by the same owner, under practically identical conditions, and the records were kept by the owner himself in the same painstaking way. The tabulated comparison is given for ready reference, but it is necessary to make some explanatory statements so that no injustice will be done to either car.

Both cars were bought new and used in successive years, the light one weighing about 1,200 pounds and costing $1,150, and the heavy one 3,000 pounds and listed at $2,200. The former was in service for eleven months, averaging a little more than 800 miles per month, and the bigger machine was actually used ten months out of the full year, being out of service in September and February, but averaging 940 miles per month. Although rated as a five-passenger machine, the light car was really better suited for use by four adults, especially on long country runs. It was driven by a 20-horse-power engine, whereas the heavy car was rated at 35 horse-power.

It is rather surprising to find that the actual cost of keeping the larger car was very nearly twice as much as the expense of the light one; it is not safe to assume, however, that it was a bad investment; on the contrary, the owner is well pleased with it and satisfied with the change he made. After all, it is a question of how much one is able to pay for his enjoyment, the 100 per cent difference in expense being chargeable to factors that go to make up the continued relish of motoring. Every motorist knows what they are and why. If he can afford it, he is willing to pay double or triple or quadruple for his pleasure—each person's indulgence in his favorite pastime must be cut to the measure of his pocketbook. It is desirable, therefore, to know approximately what a certain amount of pleasure, stated in terms of horse-power, speed, hill-climbing ability, roominess, comfort, reliability, appearance, etc., will cost; hence the value of the accompanying statement.

A car that costs 100 per cent more than another will of course double the item of interest on the investment at 6 per cent, nearly double the premiums for insurance, and greatly increase the amount of depreciation and in some States the amount to be paid for registration and driving licenses. One is scarcely prepared, however, to find that most of the running and upkeep costs are also doubled, and especially that the tire expense is multiplied four times. With the light car the largest item of annual expense was the fuel, but with the large car it was the tires. The light car averaged more than fifty per cent more miles to the gallon of gasoline than the large machine, making 15.69 miles as compared with 10.93 miles per gallon. At the same time, it occurred that the price of gasoline was raised several times during the periods covered, so that the average price during the second year was 17.3 as against 15.4 the year before. The prices of tires soared also, which accounts in some measure for the great difference in tire expenses during the two years. But the much heavier weight of the large car wore its tires out faster and the tires being of larger size necessarily cost more than those on the light car. Tires of 4 and 4½ inch sizes were fitted to the second year's machine, whereas the year previously the owner was able to use tires of 3 and 3½ inch sizes.

Of lubricating oil and grease the light car used 44 gallons in eleven months, so that average milage traveled per gallon was 213.6. As compared with this the heavier car required 81.4 gallons during ten months' service and averaged 115.5 miles per gallon.

Under ordinary circumstances the storage on a large touring car would not be very much more than on a small one, but in the accompanying statement the item is almost double, which is accounted for by the fact that a new law went into effect between the first and second seasons that made it necessary for the owner to pay downtown storage during the day time when he drove to work in the large machine, whereas the summer before he had "stored" the small car in the street in front of his building during business hours.

In the matter of miscellaneous repairs the table shows a great discrepancy between the two machines which is unfair to the big car, because the total of $176.01 includes a charge of $111.43 for general overhauling and repainting at the end of the season to make it practically like new, whereas no such item is included in miscellaneous repairs on the small car, which was sold without repainting and overhauling. Yet it may be taken for granted that an allowance to cover this work figures in the item of depreciation, which was nearly 50 per cent on the small car, but is estimated at only about 33 1/3 per cent on the large machine. Deducting the charge for overhauling places the expenses for miscellaneous repairs the second year at close to 50 per cent more than the first year. As a matter of fact, however, the owner really had much less mechanical trouble with the heavy car.

One other item needs explanation. It is that of insurance which cost disproportionately more the second year. This is because a policy to protect against collision was added to the insurance against fire and theft that was carried on the light car.

Oiling and greasing, which was done the first year by the owner, was done mostly by the dealer the second year, and is included in the miscellaneous repairs.

Magneto ignition on the heavy car eliminated any charge for a spark coil which appears the first year, and a fine of $13 paid the first year was avoided the following year. On the other hand, much more was paid out in small fees to drivers and helpers.

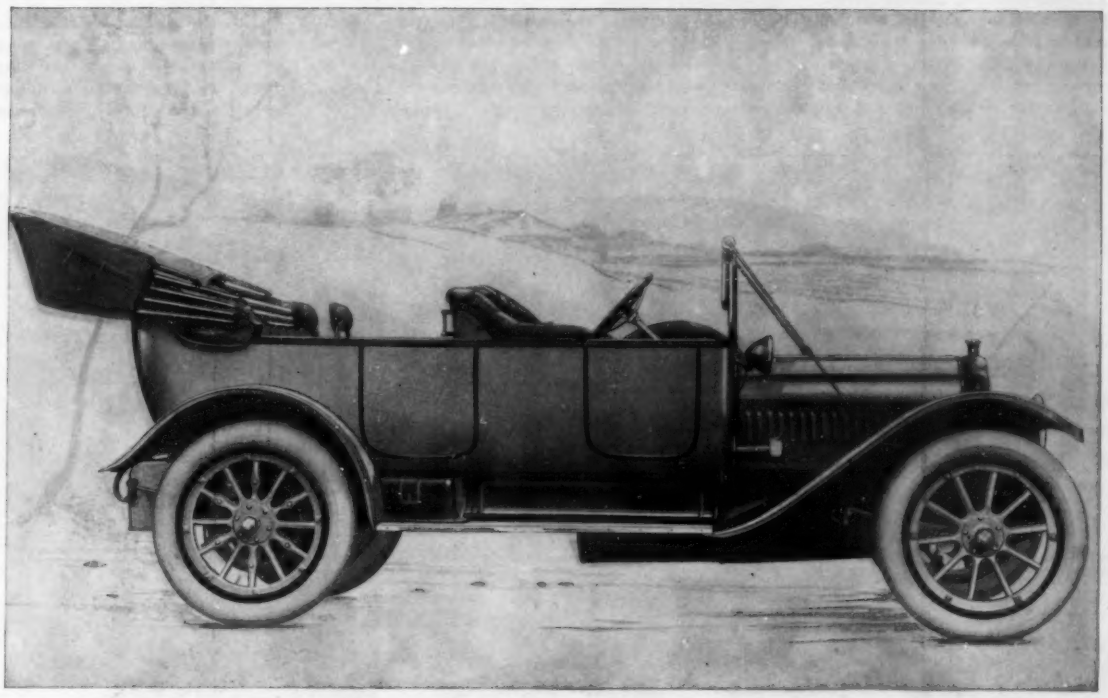
The reader may safely be allowed to draw his own conclusions from the facts presented, and decide whether the light or the heavy car is for him. Of course, it will be understood that the figures cannot be applied with any accuracy to cars of different types, such as two-passenger runabouts and cross-country cars, or to machines of greatly different powers. Inasmuch as the two machines to which the actual expense items apply are average cars, the comparative figures should be of great value.

Comparative Cost of Light and Heavy Cars.

Running and Upkeep Items.	Expense of Light Car from April 7th, 1909, to March 1st, 1910. Total Mileage, 8,833.		Expense of Heavy Car from March 3rd, 1910, to March 17th, 1911. Total Mileage, 9,400.	
	Amount Per Year.	Per Mile, Cents.	Amount Per Year.	Per Mile, Cents.
Gasoline	$87.68	1.0	$149.28	1.6
Oiling and greasing	26.49	0.3	48.87	0.5
Storage	53.85	0.6	102.30	1.1
Washing and polishing	80.25	0.9	96.25	1.0
Battery charging and lamp renewals	10.13	0.1	10.85	0.1
Sundries	26.85	0.3	55.71	0.60
Spark plugs and coils	26.95	0.3	2 00	0.02
Tires and tire renewals	79.37	0.9	*305.08	3.24
Miscellaneous repairs	46.93	0 5	176.01	1.87
Drivers' help, fines, and fees	18.50	0.2	57.10	0.6
Total	$457.00	5.1	$1,003.40	10.63
Other Items.				
Interest on investment	$69.00	0.8	$132.00	1.4
Depreciation	550.00	6.2	700.00	7.4
Licenses and insurance	42.00	0.5	102.91	1.1
Tire depreciation (to equal new tires)	Inclu. ab	ove	*65.00	0.7
Actual total	$1,118.00	12.6	$2,003.31	21.23
Cost per month of service (11 months)	* 101.63	.....	†200.00	.....

* Adding the $65 charged to tire depreciation to the $305.08 actually paid for tire repairs and renewals makes the equivalent tire expense on the heavy car $370.08, or approximately 4 cents a mile.

† Ten months.



Important News Concerning the White Six-Cylinder "60"

THE White six-cylinder "60" is now ready for the automobile world. Fifty years of manufacturing experience are back of it—twelve years of automobile-building has led up to this fitting consummation of our efforts—a superlative six-cylinder gasoline-driven car. It is just as unique and extraordinary in all its essential features as our four-cylinder "30's" and "40's"—now conceded to be the highest types of motor cars.

IN producing this "60" for the very top of our line, we have naturally spared no expense, but rather have sought to make this powerful car the most perfect sold on any market. Its engineering features have been recognized or adopted by practically all the European manufacturers, and these features to-day influence the design of every new model in this country. Only two motor factories in the world, we are told, use such materials as are characteristic of the entire White line. In liberality of equipment, in all the fine points which mark the most lavish and permanent construction, this car is superb.

The Six-cylinder car is always the supreme test of an automobile factory. Such cars are proverbially handsomely finished and offer little choice from outward appearance — the vital part of a car is under the hood, and there the White demonstrates its class. It has the compact simplicity of the en bloc system of cylinder-casting—the marvel of the engineering world. There is an almost total absence of wires, pipes, and the paraphernalia that usually litter the engine of motor cars. The engine is the powerful, long-stroke type which is undeniably the most economical. The upholstery —the body lines—the lighting—every detail, is of that type and quality which distinguishes the best the world knows how to produce.

The Output Limited

REGARDLESS of the tremendous acreage of the great White factory—regardless of its enormous equipment in machinery—regardless of its hundreds upon hundreds of workmen—it has only a certain capacity per day or per week. Built as all White cars are, this capacity cannot be greatly increased. The White "30's" and "40's" have a reputation which has constantly crowded our factory with orders during the last year; consequently, it is expected—almost a foregone conclusion—that these cars will tax our capacity in 1912. Therefore, the output of the new "60's" will be limited, necessarily. Produced in response to a definite demand for a White "Six"—even before customers had seen it, we booked order after order from blueprints. In other words, the demand has exceeded all our calculations, and we are confronted with the possibility of being unable to produce enough of these cars. From our standpoint a most satisfactory condition—but to the man who wants just such a "Six"—the superlative car—from the White factory, it may mean disappointment, unless he acts to-day.

Appointments for demonstrations can be made with White representatives in all principal cities on or after January first.

The White Company

838 East 79th Street, Cleveland, Ohio

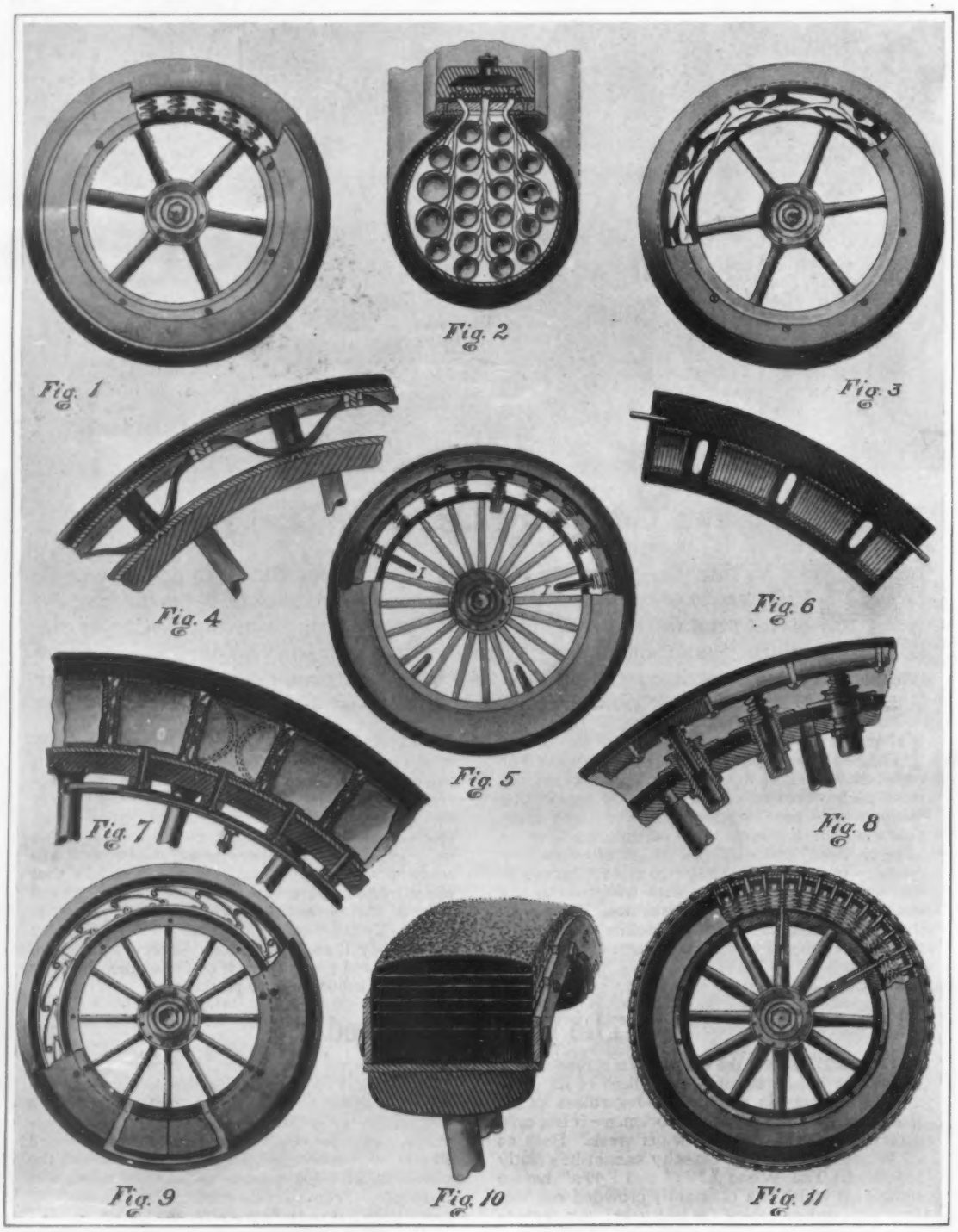
Will Rubber Tires be Supplanted?

What the Inventors Are Doing to Abolish the Pneumatic Tire and Lower Repairing Expense

HOW often, in these days of improved roads and asphalt streets, we see a fine-looking and apparently well-equipped touring-car standing like the eternal rocks at the side of the road, while an interested and intelligent audience stand idly by watching the chauffeur tinker viciously at some part of the machine. It is an every-day occurrence in the larger cities and not infrequently met with on the country pikes. Upon inquiry, we sometimes find that the engine, or the steering gear, or the transmission has gone wrong, but more often—indeed, we may say, the vast majority of times—we learn that once more a pneumatic tire has refused to do its part. A puncture, a blow-out, a rim-cut, any one of a hundred mishaps, and the high-powered car must be halted until repairs are made, or a new tire substituted—while the chauffeur and passengers gently (?) murmur a few words occasionally mentioned in the Bible. And two-to-one, the owner adds "$65 more gone up"—for it is a recognized fact that the tires are one of the most expensive parts of the machine.

With accidents and breakdowns so frequent one must wonder why the pneumatic tire is so universally employed on road-vehicles. "Why," we hear every day, "do they have to use these costly pneumatic tires? Are they so essential that nothing else can take their place?"

This question, so oft repeated, is surely worthy of consideration—many owners are hurling anathemas at the tantalizing tires—many passengers are wishing that the tiresome and annoying breakdowns could be avoided—many dealers and garage owners are besieged with requests for a cheaper and more perfect substitute—and yet, the manufacture and sale of pneumatic tires goes steadily onward—growing, expanding, multiplying, the makers ever conscious of the fact that pneumatic tires possess certain advantages, which we can only utilize by accepting their accompanying defects.



EFFORTS TO SOLVE THE TIRE PROBLEM

If we examine for a moment the function of the tire in the automobile of to-day, we find its task a severe test of endurance. The tires of the automobile must withstand all the force and impact of the engine in starting and driving the car, all the weight of the heavy machine, the shock and strain of overcoming the momentum of the car in changing directions, the friction and wear of contact with the various road surfaces, the heat generated by friction and rapid revolution, and the resistance of the brakes in retarding and stopping the car—while if a pneumatic tire is used the additional resistance of the compressed air highly heated and in a state of great agitation during the motion of the vehicle must also be overcome. Besides these necessary qualities of strength and endurance there are several features of convenience demanded by the public—ease in assembling, quick removal, ready substitution of tires about the several wheels, ease in reaching the internal elements for repairs, and permanent flexibility under all atmospheric conditions.

Several of these salient features are naturally possessed by the pneumatic rubber tire, and for this reason it has steadily risen in the public favor as inventors have improved and reconstructed it to meet the other requirements. Years ago, when the bicycle was the most popular vehicle, the rubber pneumatic tire triumphed over all its rivals and took its position as the cushioning support and elastic shoe of practically all horseless vehicles—and it has held its supremacy against all competitors during the advent and development of the automobile to its present-day stage.

Many competent automobile judges maintain that the car will never rest satisfactorily on any other footing, as the exacting duties of an automobile tire can only be fulfilled by some such highly resilient substance as rubber in conjunction with compressed air. But there are other opinions on this subject—many others—and these are based mainly on the proven ability of American inventive genius to overcome obstacles. Inventors are constantly striving to replace the pneumatic tire by some satisfactory substitute which shall combine its several advantages with greater lasting qualities and less cost.

How many automobile owners are aware of the fact that nearly one thousand (920 at present writing) United States patents have been issued on resilient or spring wheels, and nearly half as many (454) on spring tires—all designed to crowd the exasperating and costly pneumatic tire from the surface of the road. Some of these patented products have appeared and lingered awhile—on the market; others have never been manufactured and probably never will be.

There have been inventors (possibly victims of punctures) who advocated the use of a reinforced concrete tire. One has utilized a rope of the clothesline species as his tread with a spring to take up the slack, while another has compounded his tire of fiber much after the manner of a broom (see Fig. 10 in the accompanying engraving) with several concentric rows of stitches reinforcing the fiber bristles at regular intervals. The whole is so arranged that when the outer portion of the fiber has been worn down, the diameter of the tire is reduced by one row of stitches, all beyond this row being removed and a new tread surface presented.

But the schemes and plans are as numerous as the patents. Experiments have been performed, improvements designed, devices innumerable introduced, all with more or less apparent merit. A few of the later patents, mostly issued during the past year, are illustrated.

One plan of improvement (Fig. 1) is to utilize a solid rubber tire arranged to move radially within extended rim side-flanges, and to cushion this tread upon radial coil-springs suitably secured in the wheel-rim. An annular band of leather or the like is placed

(Continued on page 38.)

A Fertile Field for Inventors

(Concluded from page 11.)

fresh air into the outer shell through a group of holes at the top. Some air also enters the inner chamber through a valve at the left and the rest passes on down through a one-way valve in the lower end of the plunger and thence enters the motor cylinder. This air acts as a primary compressor to operate the pump, the charging of the motor cylinder being necessary because the three firing cylinders are operated with the throttle nearly closed, reducing the power of the primary compressor in proportion to the air admitted to it. Only pure air is forced into the tire, being cooled, before it leaves the pump, by the air taken in at the top on each suction stroke as it circulates around the spiral outlet tube.

Overheating of an automobile motor is reasonably sure to be followed by trouble and perhaps serious injury of the motor if it continues long. Overheating may be due to several causes, of which stoppage of cooling water circulation, leaking radiator, insufficient lubrication and long continued running on low gear are most common. An ingenious inventor has given us an overheat alarm of simple and durable construction. It is shown in Fig. 5. An automatic alarm operating on the principle of the thermostat is added to an ordinary petcock, which is screwed into the cylinder head for priming purposes and to relieve compression. A tapered bronze spindle *A* is passed through the petcock and held by a coil spring secured by a split-pin. Through the center of the spindle extends a steel pin *C* secured to the end of the spindle at *B*. At its inner end it is seated against a hollow screw-plug *G* to form a valve *E*. Normally, the handle *D* is set so that the petcock valve will be closed when the motor is running, as in the illustration. But if the motor should heat up beyond a safe running temperature, the bronze spindle will expand and elongate more than the steel pin, slightly opening the valve *E* in the plug. Gas from the cylinder will then enter the by-pass hole *F* in the spindle and pass through the valve and screw-plug into the mouth of the whistle in the handle *D* cast integral with the bronze spindle. The plug can be adjusted for sounding the alarm at any temperature, and is held in adjustment by a lock-nut.

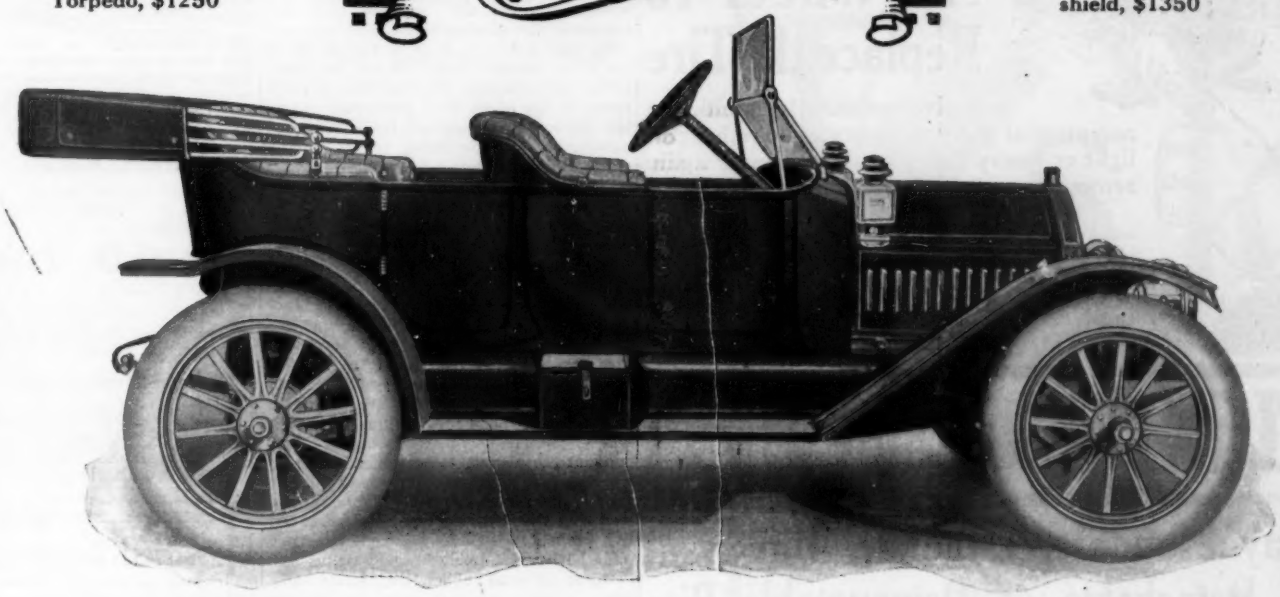
Credit must be given to the designer of one of the world's most popular low-priced automobiles for the very original and radical departure of incorporating the magneto for ignition and lighting purposes directly with the flywheel of the motor. This flywheel magneto is shown in perspective in Fig. 6, and partly in section in Fig. 7, assembled with the flywheel, transmission, and clutch in the divided clutch housing. The magneto generates a low tension or primary current, the voltage varying from nine to thirty according to engine speed. This current is transformed from low to high tension and distributed to the cylinders by a spark coil and commutator. When the motor is turned over by hand the magneto gives such a large spark that no battery is needed for starting. This magneto also generates enough current to operate electric lights without interfering with the ignition. Briefly, sixteen permanent V-shaped magnets are bolted to the face of the flywheel, with the small ends at the center and with brass bushings separating them from the iron except at their middle points where they are neutral and no leakage of magnetism through the flywheel can occur. Immediately facing the magnets is a series of sixteen armature coils secured around the rim of a circular plate fastened immovably to the rear of the cylinder casting. Each coil is supported on the plate by a pole piece. All the coils are connected in series and the terminals are brought out near the top of the plate. At every complete revolution of the flywheel sixteen electrical impulses are produced, but as the armature circuit is closed only when a spark is wanted, current flows only at that instant and there is no loss from other impulses. Only two impulses are required to produce an igniting spark to start the motor.

Many other interesting new motor car accessories might be illustrated and described, but the foregoing will suffice to show in what varied directions inventors have been working and to prove that the field has by no means been exhausted.

Five-Passenger Light Torpedo, $1250

Elmore

With Top and Windshield, $1350



The One Proven Successful Valveless Motor

Nowadays the whole automobile world is ringing with discussion as to the practicability of discarding the poppet valve, and with it the numerous gears, springs, cams, push rods, etc., which actuate it. Everybody has come to realize the simplicity and super-efficiency of the valveless construction. Extravagant claims and arguments are being made for the valveless motors now so widely exploited.

BUT JUST GRASP ONE GREAT FACT. Every such claim put forth applies with two-fold force to the Elmore valveless motor—which in a dozen years of successful service, has in the hands of owners throughout the country proved both its simplicity and its superiority. We passed the experimental stage years ago.

And the Elmore does not cost $3,000, $4,000, $5,000. There is a model to fit every motoring need, at a price well within the purchasing power of the most conservative.

The Elmore was the Pioneer in Valveless Engine Construction

We have advocated the valveless engine since the inception of the automobile industry in America. The first valveless two-cycle Elmore engine that was installed in a motor-car was a success—a great success. And each year we have refined and simplified it until, in this year's models, we are installing a motor that we believe to be as perfect as human ingenuity can make it. We ask you to prove for yourself that it is the simplest, most efficient automobile engine extant.

Elmore owners, the land over, are about the most thorough, consistent, persistent enthusiasts in motordom. In fact, they're generally referred to as Elmore "fans." Our only regret has been that in past years we have never been able to supply all the "friends of our friends" who wanted cars. For we would only turn out the number of cars that we could build 100 per cent. right in every detail. This year, with double factory capacity, we hope to come somewhat nearer to supplying the demand.

In buying an Elmore you are not buying an experiment or a novelty, but a motor tested by thousands of owners for over a dozen years—a motor which, by virtue of patent rights, no other motor-car can have.

Elmore Construction is of the Best

There could be no better built car than the Elmore. Skilled workmanship and careful supervision accompany every detail. We aim to make the car itself a worthy setting for the gem of a motor that runs it.

There is no better inspection system in the world than that which assures to Elmore owners the absolute flawlessness of every Elmore part. And exactly the same care is used in the selection of the materials and the finishing of the product.

Whether your need be for a roadster or for one of the various types of touring car, you will find an Elmore model which in appearance and in service will rank with any car at any price. And the wonderful, exclusive Elmore motor, assures you a smooth, sweet running car with the utmost in power efficiency, and with an entire absence of valve troubles and valve expense.

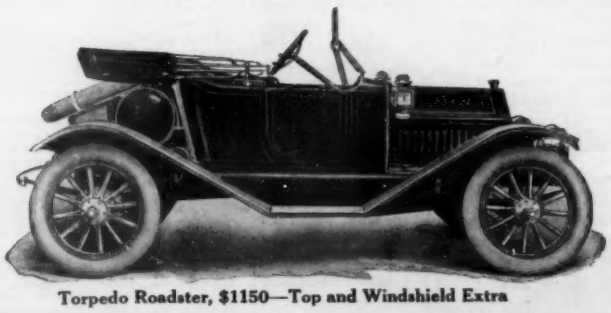
Write for the Elmore Book

We have prepared a very interesting booklet about the Elmore car, which will be sent free on request, together with the name of the nearest dealer where you can see and test this wonderful car for yourself.

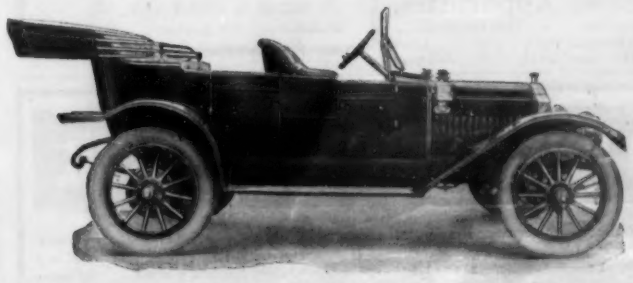
THE ELMORE MANUFACTURING CO., 51 Amanda St., Clyde, Ohio

DEALERS—For 1912 we have doubled our factory capacity, thus enabling us to double our output. We are therefore enabled to take on a few additional dealers in sections not yet allotted. Write us for 1912 proposition on the one moderate-priced **"car with a reason."**

See us at Madison Square Garden Automobile Show, Space No. 105, Elevated Platform



Torpedo Roadster, $1150—Top and Windshield Extra



Five-Passenger Touring Car, $1600—Top and Windshield Extra

Gasoline in War

(*Concluded from page 18.*)

examine the motorcycles and riders enlisted at these depots at irregular intervals. Riders must keep the government informed at all times of changes of address or of the sale or exchange of their machines; they must also keep the authorities continually informed as to the whereabouts of the machine and any change of the storing place.

Strange it would seem to the shade of the great Moltke, could he see the sputtering two-wheelers flit over the country roads at the speed of a hurricane, carrying important dispatches from the commander to the provision trains in the rear, where in place of the slow-moving lumbering horse-drawn wagons huge motor trucks rumble ponderously along, carrying each enough provisions to feed a battalion for a week; if he could see immense platforms resting on rubber-tired wheels and carrying quick-firing guns capable of shooting perpendicularly into the air; if he looked up into the blue sky and discerned there flitting shadows like gigantic birds, peering from the heights into every nook and corner of the landscape below, so that hostile troops cannot find a hiding place or ambush. Everywhere the chug-chug-chug-chug of the combustion engine, the pungent odor of burning gasoline and overheated oil, the flitting by of phantoms bent low upon whirring wheels, the faint hum of revolving propellers in the atmosphere above and the heavy rumble of road trains and artillery on solid rubber tires, would show him the difference that three decades can make in the fighting force of a country. In 1880 the horse was an absolute necessity in warfare—to-day, in 1911, gasoline reigns supreme and the horse is relegated to the rear. What business has a horse in war anyway? "War is hell," said a certain American general, and gasoline smells more like the popular conception of sulphur-and-brimstone-Satan than the docile horse. So—let gasoline fight and the horse rest!

The Pleasure Boat's Debt to the Racer

(*Concluded from page 15.*)

far over to one side. This tendency was illustrated in a race in which two motor boats rounded a buoy "neck and neck." The outer boat leaned far over, as she always did on a turn, but the "wash" of her companion aggravated the suddenness and degree of this list, so that the two occupants of the former craft were hurled out into the water.

When the men were hurled from the racer, the tiller had been left turned for the buoy, and the lightened boat still tried to edge sharply into her companion. As she gained on her rival and began to pass her, the pilotless craft started to cross the bows of the boat at the pole. The bow of the inner boat struck the runaway a glancing blow that served to roll the latter completely over, and by the time she had again righted herself, her motors had stopped, due to the water that had found its way into the carbureter during this unexpected imitation of a porpoise.

This incident illustrates the stability which even a high-powered racer can possess, and it is evident that there is a great advantage in keeping the center of gravity of any motor boat as low as possible. Designers are quick to take advantage of the lessons learned from races, and every motor-boat owner is the gainer thereby; for what applies to one, holds good, more or less, in the case of all motor boats, whether they be slow or fast, large or small.

The improvements in high-speed motor boats during the last decade have not been entirely along the lines of hull design, although this contributes largely to the increased efficiency of the racers during recent years. Were it not for the fact that motors have been lightened, and that several times the power of former years can be obtained from the same weight, the delicate hulls could never even float immense power plants that now drive them through the water. Then, too, improved balance in the moving parts of the motors has so reduced the violence of the vibrations that a 200-horse-power motor of to-day will be as smooth-running as was one of one-fourth that power a few years ago.

The following table illustrates these points and shows, by taking the representative racers of their day, how the power has been increased in approximately the

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry may be repeated. **MUNN & CO., Inc.**

Inquiry No. 9246.—Wanted, addresses of parties having raw materials or minerals containing potash in any form.

Inquiry No. 9247.—Wanted, to buy a Parmelee aerated water.

Inquiry No. 9254.—Wanted, the name and address of manufacturers of lead pencils and pen holders, such as are used for printing advertisements on.

Inquiry No. 9255.—Wanted, to buy a patent roller, a ball-bearing axle, which could be purchased on a royalty basis; it must be cheap and fully proved.

Inquiry No. 9256. Wanted addresses of parties having Pitchblende deposits, if able to ship ore.

Inquiry No. 9257. Wanted addresses of firms selling second-hand water turbines.

Inquiry No. 9258.—Wanted addresses of parties having gem materials to offer in any part of the world.

Inquiry No. 9259.—Wanted to buy a machine for removing the coating of a filbert.

Inquiry No. 9260.—Want addresses of parties able to ship corundum, garnet, flint, emery or any material suitable as anabrasive.

Inquiry No. 9261.—Wanted, a manufacturer to make card games

Inquiry No. 9262.—Wanted, to buy a glass which is a conductor of electricity, and the address of the makers of the same.

same waterline length of hull. But more striking than this, the table shows that, above thirty miles an hour, each mile or two additional speed is only obtained after the utmost effort on the part of hull and engine builder; and if one considers only the number of failures to attain the expected speed, without looking at the successes, he would think the designer's job a most disheartening one.

	Name.	Length.	Beam.	Horse-power.	Speed.
		Ft. In.	Ft. In.		M.P.H.
1903	Standard	60	6 6	110	24
1904	X P D N C or Vingt et Un	44	6	48	26
1905	Pirate	39	6 6	120	28
1906	Pirate	39	6 6	128	28
1907	Dixie	39 11	5	133	32
1908	Dixie	39 11	5	133	33
1909	Dixie II	39 3	5 5	260	33
1910	Dixie III	39 5	5 5	260	35
1911	Disturber	39 11	5 6	500	37

The Selection of a Motor Truck

(*Concluded from page 17.*)

and need the weight to give good traction, while the front wheels are relieved of most of the weight and steering is therefore made easy. On their side, builders of the seat-over-engine type assert that with the same wheelbase their machines provide a longer load platform with less overhang at the rear, divide the weight more uniformly on the frame, springs, axles, wheels and tires, and elevate the driver to a position well above traffic where he can better observe other vehicles.

Manufacturers of gasoline machines of all types are giving a great deal of attention to the subject of accessibility of all working parts. They do not underestimate the importance to the business man of keeping his trucks and wagons in regular service. It is intolerable to keep a machine laid up in the shop for a day or a week for some minor trouble that cannot be remedied without tearing down a lot of mechanism that is so located as to prevent access to the defective part. Vehicle builders not only locate their engines in front, where they can be reached easily through hinged doors or tipping seats, but several of them provide removable power plants so mounted on subframes that, after disconnecting a few pipes, the engine and transmission can be withdrawn from the vehicle and a duplicate substituted for it, thereby enabling the vehicle to return to work after a delay of perhaps an hour or two, while the original power plant remains in the shop to be given careful attention.

Nearly all makers of first-class heavy gasoline trucks now support the radiator on special springs of some sort to relieve it of the jolting that otherwise would soon open up the seams and cause it to leak. Bumpers to protect the radiator against collision are also becoming universal. Usually they are in the form of a heavy cross member of the frame extending several inches in front of the vulnerable member. Protection of the drive chains is provided in several high-priced trucks by metal chain cases fitted over the sprocket wheels. All other parts of the propelling mechanism, from the engine in front to the differential gear on the countershaft, are entirely inclosed in strong castings to exclude dirt and water and retain lubricating oil and grease. To eliminate friction, all wheels and shafts rotate on roller or ball bearings in the best machines.

General excellence in any machine is dependent upon materials and workmanship as much as upon design, for which reason it is well for the intending purchaser to know something about the company that builds the machine he proposes to buy. A poor quality of steel in the transmission shafts or live axles, or improperly heat-treated gears, may cause endless trouble and expense.

An excellent opportunity to observe and compare different construction in commercial vehicles and to discuss various phases of the subject of motor trucking and delivery will be presented by the national automobile shows in New York from January 10th to 20th, and in Chicago from February 5th to 10th. During the winter and early spring there will be special commercial motor vehicle exhibitions also in Philadelphia, Pittsburgh, Boston and several smaller cities. At any of these the man in quest of knowledge on the subject will be able to pick up much interesting and useful information.

Driving the Car at Night

(*Concluded from page 18.*)

not easily removable when it is desired to use the full strength of the lights. To overcome this difficulty, a two-way valve has been devised, by means of which two different pressures of gas at the burners may be obtained. By means of a reducing valve at the tank or generator, these pressures may be so set that one will give a light of maximum brightness, while the other will serve merely to keep the flame burning without the objectionable glare. Another device for reducing the glare of the headlights consists of a small, dull metal disk which is attached to each burner by means of an adjustable bracket. In its normal position, this disk rests below the flame back of the burner; but by moving one end of the lever arm to which it is attached, the disk will be raised and will interpose itself between the flame and the reflector. The dull metal, of course, possesses no reflecting power, and consequently the acetylene light will be no brighter than would be the case were the flame burning in the open air. By means of a fine wire, the disks may be operated from the steering column or from any other location within convenient reach of the driver.

The ordinary brackets on which the headlights are mounted are stationary, and consequently the rays from the lamps are always thrown directly ahead of the car. The man who desires to "see around a corner," however, may install a pair of swiveled brackets which are connected with the steering knuckles of the front wheels. By this arrangement, the rays are always thrown in a line parallel with the vertical plane in which the front wheels are turned, and the side of the road is illuminated before the car actually rounds the corner.

Instead of being a novelty nowadays, the electrically-lighted car is as common as was the automobile using acetylene gas a few years ago. For some years, electric lights have been used for the interior illumination of limousines, and in such instances, current was obtained from a separate storage battery which required frequent recharging from some exterior source. But in order to operate ten or a dozen electric lights on an automobile, either a storage battery of large capacity and consequently of unwieldy proportions would be needed, or a separate generator would be required to furnish current whenever the motor was running. The most general solution of the electric lighting problem has been found in the second method, and many cars are now equipped with mechanical current generators driven by the motor. Such a dynamo may be driven either by a gear attached to the front train or to the pump, magneto or transmission shaft, by a silent chain connected with a sprocket mounted on one of the shafts, or by a friction belt or pulley in contact with a surface of the flywheel. It is a common practice to use a storage battery in connection with the generator so that current may be furnished for short periods when the motor is not running, or when it is revolving too slowly to drive the dynamo at a sufficient speed. Such a storage battery is so wired that any excess current generated by the dynamo "overflows" into this storage cell, and thus the battery is kept charged automatically.

In many systems, the magneto for furnishing ignition current, and the dynamo for supplying power for the lights, are two independent machines—both, however, being driven by the motor. In other types, a single generator is used for both purposes; but such a machine must be of special design and construction to serve the two requirements. In one system, the single generator not only furnishes both the ignition and the lighting current, but also supplies power for operating a self-starter for the motor, as well.

Whatever lighting system is used, the motor-driven dynamo will furnish sufficient current for the operation of at least two powerful headlights, a searchlight, two side lights, a tail light, and several lamps distributed in the interior of the car (if a closed machine) and on the dashboard. The limousine may be equipped with side lights, as well as the overhead "dome" light, and these may be operated by separate switches set in the panels. Small electric gage and indicator lamps for illuminating the instruments on the dashboard are also useful, and by

them the driver may be informed as to the time, the speed of the car, the adjustment of the oil feed, and the pressure in the fuel tank as well as in daylight.

The improvement in the construction of Tungsten filaments has enabled this efficient, bright, white light to be used with great success on motor cars, and such bulbs are adapted for the headlights as well as for the other lamps. For converting oil-burning side lamps into electrically-operated lights a clamp is provided which can be attached easily to the kerosene burner. To the other end of this clamp is fastened the socket into which the small electric bulb screws, and as the former is adjustable, the light may be set in the proper relation to the small reflector. Acetylene-burning headlights cannot well be "electrified," as the shape of the reflector in the two types of lamps is different. Inasmuch as the electric lamp needs no air draught, the reflector may be made of the "true parabolic" shape, thus giving somewhat the effect of a hollow cone, open only at the large end, or "base," with the light located at the "apex." The socket in which the bulb rests is sometimes made adjustable so that the desired focus may be obtained, and the rays can be either spread or concentrated, with an attendant increase in brightness under the latter condition.

There are many attachments which may be used in connection with the electric lighting system on a motor car, such as a cigar lighter, operated by the push of a button, and which will not be affected by the wind; a "trouble hunter," or small electric hand lamp attached to the end of a flexible cord; and other ingenious devices which render driving at night not only safe, but comfortable, and even luxurious.

The Motorcycle of 1912

(Concluded from page 19.)

bearings for hubs are fitted to two makes, one introducing the innovation last year. This type of bearing has greater load capacity and durability than the ball bearing. Fuel tanks are larger, now holding from two to three gallons of gasoline, and one-half to one and one-half gallons of oil. From 50 to 90 miles on a gallon of gasoline may be expected, according to the size of the motor and carbureter adjustment. The average oil consumption is 650 miles to the gallon.

There has been much detailed refinement in motors, but little of a radical nature. Cylinder dimensions remain the same generally, although two or three makers have enlarged these units. A four-cylinder engine is used on one make of machine. Bearings have been increased in size, and one manufacturer has changed from ball to roller, but the majority use plain bronze. Mechanical inlet valves are the rule, although one or two stick to the automatic or suction type. The overhead rocker valve arrangement is gaining favor, particularly for inlet valves. Valve mechanisms show considerable improvement.

In lubrication there is little that is new. The most general system used is an adjustable sight gravity feed to the motor, but three makers are using a mechanical pump, and hand pumps also are fairly numerous.

At present the belt drive with flat belt is the leader, but the chain gives indications of returning to the high favor it once enjoyed. Every manufacturer of note, even those who build chain or shaft-driven machines, also is offering a belt model, but the chain has secured two important recruits in the past year. The V belt also is used to a rather limited extent. In the hands of the average owner, the belt drive will give the best service with the least amount of care, and even when much abused, and it is the quietest and smoothest form of drive. In wet weather, or on high-power machines, it is at a disadvantage, and the chain-drive scores heavily. The shaft drive is used by a long established maker, and two or three newcomers.

There is a very general tendency to standardize models by building only two sizes of motor with many parts interchangeable, as well as wheels, frames, and other units. The two-speed gear has gained another adherent, there now being five manufacturers who employ it. Here again, motor car practice is apparent, the sliding gear, planetary, and individual clutch types of transmission being used. Steering has been made safer by strengthening the front forks, frame heads and

handlebars, and fastening the last so that they cannot be wrenched out of line with the front wheel.

In appearance and finish the average machine of 1912 is handsomer than its predecessors, as well as faster, more durable and more reliable. Not only will the purchaser of a 1912 motorcycle get more for the same money than he could get before, but he will get more for less money than ever before was possible.

Will Rubber Tires Be Supplanted?

(Concluded from page 26.)

between the rubber tire and the outer ends of the springs to protect the tire from wear.

Another plan of improvement (Fig. 5) intends the use of radial coil springs positioned over lugs on the periphery of the wheel rim, while the outer tread rim is formed of removable interfitting rings securing between them a solid rubber tread and sliding over the inner or wheel rim. The outer ends of all the springs are arranged in bosses on the inner surface of the tread rim. Devices are included to prevent relative circumferential movement between the rims.

To prevent undue heating of the springs during the rotation of the wheel openings *I* are provided for the admission and circulation of air, truly an air-cooled tire.

A clever device for allowing each spring to assist and be strengthened by its adjacent springs is shown in Fig. 9. Each leaf spring is hinged at its inner end to a securing plate upon the wheel rim and at its outer end carries a roller suitably journaled to rotate upon the upper surface of the next adjacent spring. The outer rim is formed with a suitable tread and an inner wearing ring adapted to rest upon the rollers on the ends of the springs. Any pressure upon one spring due to the inward movement of the outer rim will be transmitted to and be taken up by the adjacent springs as well. (Patent No. 976,667.)

Another form of tire (Fig. 6) shows the use of steel coiled springs vulcanized within a body of resilient composite material, the springs being wrapped with canvas and covered with end caps to protect the inner portion of the tire from wear. (Patent No. 991,744.)

Another inventor plans the use of semi-elliptical springs (Fig. 3) between an inner or wheel rim and an outer tread rim, the inner ends of the springs resting within elongated slots in the inner rim—while a rounded projection on the central portion of the springs fits within a correspondingly shaped socket on the inner surface of the outer rim to permit rocking of the springs during the rotation of the wheel. A rubber tread is preferably provided for ground contact, while the elliptical springs are alternately arranged in two rows for the sake of strength. (Patent No. 983,008.)

Still another inventor advocates the use of rubber blocks in conjunction with springs between the wheel rim and an outer channel rim movable eccentrically upon the wheel rim (Fig. 4). The springs are shown as semi-elliptical leaf springs with their central portions secured to the wheel rim, and the inner ends of the rubber blocks are fastened to the wheel rim by the same securing members. In order to prevent too great circumferential movement of the tread rim, the ends of the springs overlap and are provided with communicating slots into which project inwardly extending lugs carried by the tread rim. (Patent No. 991,612.)

A class of inventors desire to utilize the resiliency and advantages of a pneumatic tire but to eliminate to a great degree the danger of the tire collapsing after a puncture. An example of this kind of improved tires is shown in Fig. 7.

The outer tube or shoe is constructed in the usual manner, but instead of a continuous inner tube, a number of expansible rubber sections are provided, each of which is arranged between two sheets of flexible fabric cemented at their edges within the outer tube. Whenever one of these sections is punctured only the air within it will escape, and the air in the adjacent sections will expand as the side pressure is reduced, forcing the flexible fabric sheets into the space formerly occupied by the punctured section. All the sections are preferably connected to a circular air-distributing tube for ease in pumping up the tire. (Patent No. 893,832.)

(Concluded on page 36.)

Another device on the same principle is shown in Fig. 2. Within an outer shoe of the ordinary type is arranged a plurality of separate small pneumatic tubes, each of which is provided with an inflation tube leading to the general inflation valve. When pumped up, the individual tubes completely fill the outer shoe with air under compression, and the puncture of any one tube will only slightly lower this pressure, the air in the others quickly expanding to take up the space formerly occupied by the punctured tube. (Patent No. 925,580.)

Another plan is to connect loosely a number of metallic shoes to form a tread ring within a rubber casing, and cushion the inward movement of each shoe by a separate coil-spring (Fig. 8). The coil-springs and the shoes are maintained in position by radially extending guides on the inner surface of the shoes telescoping within a hollow cap suitably secured in the wheel rim. The springs may also be tensioned at will by rotating the caps. (Patent No. 986,049.)

Another inventor favors the use of radially-extending studs or tread-pins disposed around the rim of the wheel (Fig. 11) and suitably cushioned by radial coil-springs. The heads of the tread-pins serve to prevent skidding, and relative circumferential movement of the tire and rim is obviated by extending the shanks of some of the pins into sockets cut in the wheel spokes. In the wheel illustrated, the coil-springs are fastened at their inner ends upon the wheel rim, while their outermost coils surround the inner extremities of the tread-pins, collars being provided upon the tread-pins to engage the springs. Annular spring bands are also provided under the heads of the tread-pins to augment the coil-springs. (Patent No. 989,049.)

From the several devices shown, which should be regarded merely as examples, it is evident that inventors are bending every energy toward devising a practical and satisfactory substitute for the pneumatic tire. A few more years and their results will be more generally known, and some may be in common use.

There has been a gradual evolution of all the several parts of the automobile. The engine of the original automobile is a long-since forgotten type; the chassis and tonneau have undergone remarkable changes at the hands of the designers and inventors; the torpedo-body car of to-day is a long step from the road wagon shown in the famous Selden patent. Who can foretell the future strides in the development of the tire?

The Current Supplement

THE third and last installment of H. L. Heathcote's interesting article on Wheels, Ancient and Modern, appears in the current issue, No. 1879, of our SUPPLEMENT.—An article, illustrated with a full-page half-tone, is devoted to a suction gas producer for use with wood refuse as fuel.—An important subject dealt with in this number is the measurement of shaft horse-power, by the angle of twist.—The orbit of Beta Persei is discussed by J. B. Cannon.—An historical review showing the development of the marine steam turbine from 1894 to 1910 is given by Sir Charles A. Parsons.—The circulation of the elements in nature is the subject of much scientific and practical interest; a special phase of this—The Nitrogen Cycle as it Affects Agriculture—is dealt with by E. S. Holmes.—The entire potash supply of the world is drawn practically from one source exclusively, the salt deposits of Stassfurt, Germany. It is natural that we should seek for sources of domestic production of this important plant food. The efforts in this direction which are at present being made and planned in the United States are summarized in a short article on the Potash Supply.—A Throttling Two-Cycle Engine is described by Mr. C. F. Jenkins.—An important article derived from the *Journal of Industrial and Engineering Chemistry* deals with the manufacture and performance of the Edison Storage Battery. No person interested in this subject can afford to let this article pass by unread.

Aeronautical Weather Service in France.—It is reported that French aeronauts are to organize a special weather service for their own benefit, independent of the Bureau Central Météorologique. If their plans are carried out, France will be the second country to possess a meteorological service for aeronauts.

"Training Captains of Industry"

In the Scientific American of January 20, the Managing Editor of the Scientific American, Mr. Waldemar Kaempffert, will show the manner in which Germany systematically trains men to conduct great corporations. His article is the result of a study of the more important German commercial high schools.

To teach the science of commerce and the attitude which the business man must assume towards the state, the world, and his immediate competitors in business; to lift him above the level of mere shop-keeping; to make the corporation president enough of an engineer to build and sell gas engines intelligently, enough of a chemist to judge metals, cottons, and other textiles correctly, enough of a scientist to make him realize that buying cheaply and selling at a profit are the least significant features of big business, is the aim of these wonderful schools.

This will be the second of a series of articles on the part that science plays in German industry.

Watch the Scientific American advertising pages for announcements of the subsequent articles.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12586) R. L. asks: Does salt water freeze? I mean can salt be in a state of dissolution in ice, or is it as little particles of salt mixed inside? If it does freeze, will you be so kind as to tell me the freezing point for a saturated solution, and will you explain to me why polar ice is said to contain less salt than usual sea water? A. If a solution of salt in water is cooled below the freezing point and ice forms, the ice is from the water alone, and does not contain salt. At 22 degrees below freezing, Centigrade, the solution becomes saturated by the removal of water as pure ice. After this ice and salt separate together from the liquid in a constant proportion. About 25 per cent of salt and 75 per cent of ice are crystallized from the mixture and at a constant temperature. When the solidification is complete by continued cooling there is a mixture of ice and salt in crystals. The lowest temperature which can be produced by a mixture of salt and ice is therefore —22 deg. Cent., which is 7 degrees below zero. Fahr. We have no figures as to the saltness of ice at the poles of the earth, and do not know why it is not as salt as other ocean ice.

(12587) R. P. D. writes: Answering the inquiry of J. T. P., No. 12,564, I will say that having gone over the ground he wishes to cover, I will give my experience. For the "pinhole" use a piece of sheet brass, the very thinnest to be had. (Get it from some machinist who uses extremely thin brass for certain work.) In the center of a convenient sized piece make a small depression with the head of a pin or a center punch, rub the protruding portion on an oilstone to get the metal still thinner, push a cambric needle partly through, and rub again; continue till the hole is through. Work slowly and with great care (the hole must be free from any burr) and next free from any bright metal. This is done by smoking the finished job in a candle till it is well blacked. In fine, the hole is like a lens, about 98 per cent of the camera. Make the hole a work of art, and the resulting pictures will compare favorably with the work of a good lens. The nearer the plate to the pinhole, the wider the angle will be the picture. Make some suitable cover to shut out the light till ready to make the exposure. The time for an interior will be about two hours with the window blinds closed; for landscapes with bright light, about 10 to 15 minutes. If edinol restrained with acetone sulphite (Bayer's) is used for developing the plates, so wide a range of exposure is allowed that one could hardly over-expose.

(12588) R. C. H. says: Is it easier to swim in shallow water or deep, both fresh? In the first place, it was questioned whether a body was as buoyant in shallow water as in deep (whether displacement same). Then as a point one stated this argument was irrelevant, inasmuch as the floating of wood or any like body could not be likened to a live body swimming; that other things affected swimming besides buoyant effect of the liquid (not considering physical wearying effects). Can you from my attempt at telling the situation and points of discussion tell us: First, what is this muscular effort or whatever it may be called that enables us to swim or float? Is a person capable of floating (fresh water) without exerting any effort at all (theoretically and practically) in still water, in flowing water? Second, does the depth of water affect this in any way, not considering buoyant quality of water at all? Third, is the buoyant force of the water the same at all points equally distant below the surface of the water irrespective of the depth below the point? A. We know of no reason why it should be difficult for a man to swim in water of one depth rather than water of another depth, provided the water is deep enough to float him clear of the bottom. Whether the human body will float in fresh water or not depends upon the specific gravity of the body. A fat person has a lighter specific gravity than the water he displaces, while a very thin person may have a slightly greater specific gravity, and be unable to float in fresh water. Here again the question of the expansion of the lungs is involved. With full lungs the body floats higher out of water than with lungs contracted. In general, therefore, you may say that a little more effort may be exercised to hold the body at the surface in fresh water than in salt, but the difference is so small as to be of practically no importance; that some persons find it easy to float in fresh water, while others find it necessary to aid their buoyancy by swimming, and that depth of the water makes no difference whatever, as long as it is deep enough to give the swimmer room.

My Farewell Car

By R. E. Olds, Designer

Reo the Fifth—the car I now bring out—is considered by me as pretty close to finality.

So close that I call it "My Farewell Car." I shall let it stand as my topmost achievement.

Embodied here are the final results of my 25 years of experience.

I have spent 18 months on Reo the Fifth. For three months I stopped the whole Reo production to devote all of our efforts to this one car.

The future is bound to bring some minor changes—folderols and fashions. But in all the essentials this car strikes my limit.

Better workmanship is impossible, better materials unthinkable. More of simplicity, silence, durability and economy can hardly be conceived.

I consider this car about as close to perfection as engineers ever will get.

My 24th Model

This is the twenty-fourth model which I have created. My first was a steam car, built in 1887—25 years ago. My first gasoline car was built in 1895—17 years ago.

My whole life has been spent in building gasoline engines—the Olds Gas Engines, famous half the world over. My engine-building successes gave first prestige to my cars. For the motor, of course, is the very heart of a car.

So it came about that tens of thousands of motorists have used cars of my designing. They have run from one to six cylinders, from 6 to 60 horsepower. They have ranged from little to big, from the primitive to the modern luxurious cars. I have run the whole gamut of automobile experience.

In the process of sifting I have settled down to the 30 to 35 horsepower, 4-cylinder car. That is, and will doubtless remain, the standard type of car.

Greater power is unnecessary; its operation expensive. Weight, size and power not needed bring excessive cost of upkeep. Most men who know best, and who can own good cars, are coming to this standard type. So we make for the future just this one type of car.

And in this new car—called Reo the Fifth—I have embodied all I know which can add one iota to the real worth of a car.

My Thousand Helpers

But Reo the Fifth, despite all my inventions, belongs to other men more than to me. A thousand men have contributed to it. I have searched the whole world to secure for each part the very best that any man has discovered.

For that is the essence of motor car designing—to learn what is best and adopt it. No modern car owes more than a trifle to the genius of any one man.

So this car is not mine—it is merely my compilation. It shows my skill in selection—in picking the best—more than my skill in designing. It shows, above all, what my myriads of cars in actual use have taught me.

And I frankly confess that I owe a great deal to the many brilliant designers whom it has been my good fortune to associate with me.

Where This Car Excels

In Reo the Fifth you will find many good features found in no other car. You will find all the best features used in other up-to-date models. You will find them combined with style, finish and appearance which marks the very latest vogue.

But the vital advantages of this new car lie in excess of care and caution. In the utter exactness—in the big margins of safety.

One of the greatest lies in formulas for steel. I have learned by endless experiment—by countless mistakes—the best alloy for each purpose.

All the steel that I use is now made to my order. And each lot is analyzed to prove its accord with the formula. Experience has taught me not to take any chances.

I used to test gears with a hammer. Now I use a crushing machine of 50 tons capacity. And I know to exactness what each gear will stand.

I took the maker's word on magnetos at one time. Now I require a radical test, and I have found but two makes which will stand it.

The axles are immensely important. I use Nickel Steel of unusual diameter, and fit them with Timken Roller Bearings.

The carburetor is doubly heated—by hot air and hot water—for the present grades of gasoline.

The car is over-tired.

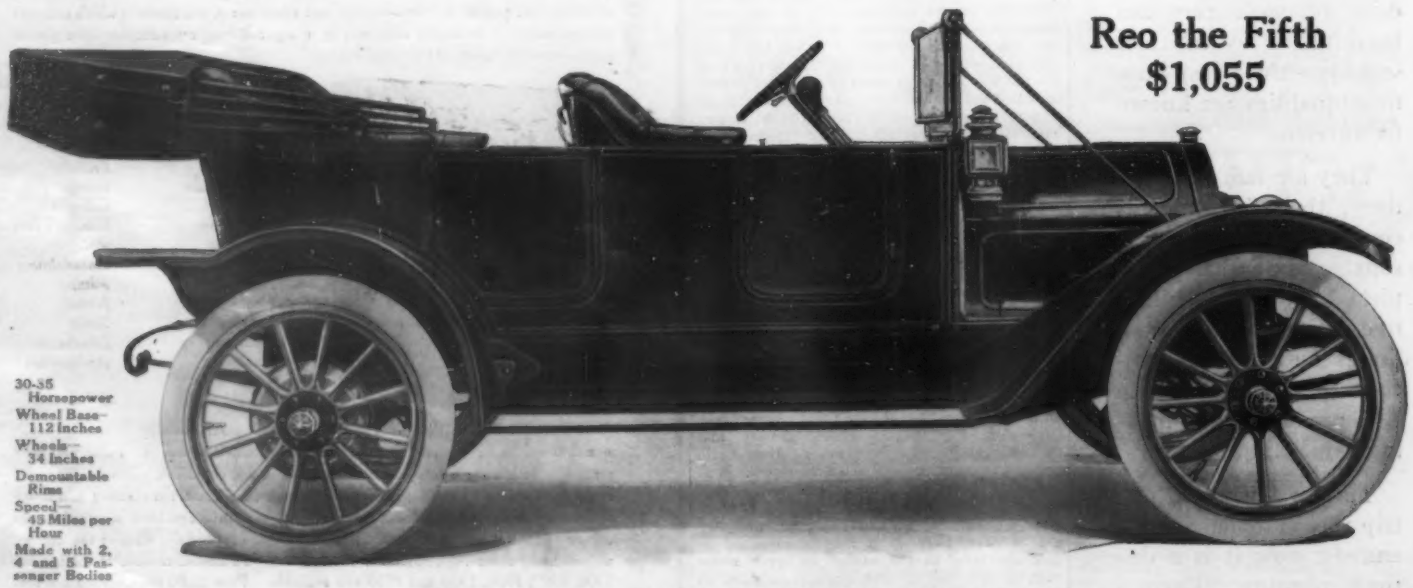
So with every part. From start to finish this car is built under laboratory supervision. The various parts pass a thousand inspections.

It is one thing to build a theoretical car, to meet all expected conditions. It is another thing to build one to meet actual conditions. The unusual and unexpected bring out a car's weakness.

The best thing I have learned, in these decades of experience, is the folly of taking chances.

I had one of these new cars run for ten thousand miles—run at top speed, night and day, on rough roads. That is equal, I figure, to three years' average usage. Then I took the car apart, and I found every important part in the whole car practically as good as new.

That's where this car excels—in that excess of caution taught by 25 years of experience. I am not abler than other designers. I have simply been learning longer.



Reo the Fifth
$1,055

30-35 Horsepower
Wheel Base—112 inches
Wheels—34 inches
Demountable Rims
Speed—45 Miles per Hour
Made with 2, 4 and 5 Passenger Bodies

Top and windshield not included in price. We equip this car with mohair top, side curtains and slip-cover, windshield, gas tank and speedometer—all for $100 extra. Self-starter, if wanted, $25 extra.